

T-87528

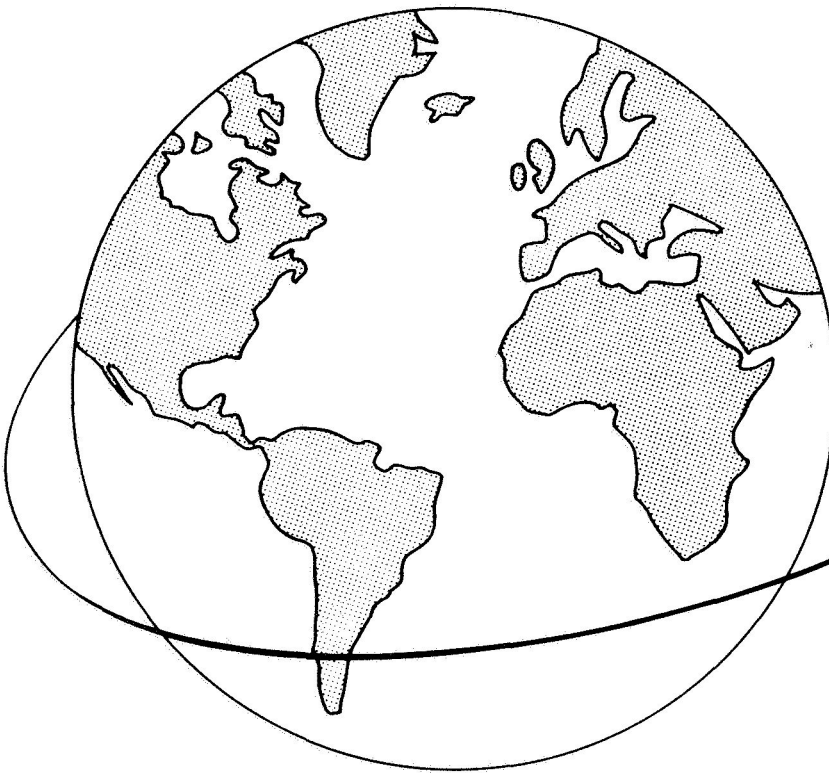
N69-23161

NASA-CR-100660

FIRST-ORDER PLANETARY THEORY

S. E. HAMID

CASE FILE
COPY



Smithsonian Astrophysical Observatory
SPECIAL REPORT 285

Research in Space Science
SAO Special Report No. 285

FIRST-ORDER PLANETARY THEORY

Perturbations in Rectangular Coordinates, Hansen's
Variables, Longitude, and Distance

S. E. HAMID

September 3, 1968

Smithsonian Institution
Astrophysical Observatory
Cambridge, Massachusetts 02138

To the memory of Dirk Brouwer

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
ABSTRACT	v
1 INTRODUCTION	1
2 DEVELOPMENT OF BROUWER'S THEORY TO THE THIRD ORDER	3
3 BROUWER'S SOLUTION OF THE EQUATIONS	11
4 THE SUGGESTED DIGITAL COMPUTER APPROACH	15
4.1 Definitions	15
4.2 The First-Order Theory	16
4.3 Comparison with the Work of Clemence	25
4.4 Analytical Comparison	27
5 RESULTS	29
6 ACKNOWLEDGMENTS	33
REFERENCES	35
APPENDIX A: FIRST-ORDER THEORY. PERIODIC AND SECULAR TERMS	A-1

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Adopted planetary elements.	30
2	Adopted values of n used in the harmonic analysis.	31
3	Running time	32

ABSTRACT

Brouwer published a method of calculating perturbations in rectangular coordinates. It is the most convenient, streamlined method to be carried to higher orders on a digital computer.

A general computer program to compute the first-order theory by this method has been constructed. Literal expansion of the various functions involved has been avoided, being replaced by single- and double-harmonic analysis techniques.

The program's input consists of the sequence number of the perturbing and the perturbed planets and the number of points used in the harmonic analysis. The output is the Fourier series representation of the first-order perturbations in the rectangular coordinates.

Two approaches for solving for the constants of integration have been incorporated into the program. The first assumes that the perturbations in position and velocity are equal to given quantities at the initial epoch. The second, following Brouwer and Clemence, assumes that the perturbations in the z coordinate do not contain $\sin \ell$, $\cos \ell$ and that the perturbations in the longitude do not contain the terms C_0 , $C_1 t$, $\sin \ell$, or $\cos \ell$, where ℓ is the mean anomaly of the disturbed planet, C_0 and C_1 are constants, and t is the time from epoch.

The program has been applied to compute the first-order theory of Mars as perturbed by the other planets. The planetary elements employed by Clemence in his theory of Mars were used for a numerical check on our program. Our results agree almost exactly with those of Clemence.

Another check carried out successfully through the program was to prove that the Fourier representation of the perturbations expresses analytically the differential equation defining these perturbations.

The program is so constructed that it can compute higher order terms once the first-order terms are available. The program has been applied to compute the first-order theory of all the planets except Pluto. The results for that work are given in the appendix of this report.

RÉSUMÉ

Brouwer a publié une méthode pour calculer des perturbations en coordonnées rectangulaires. C'est la méthode simplifiée la plus convéniente à être employée jusqu'aux plus grands ordres sur une machine à calculer digitale.

Un programme pour machine à calculer ordinaire a été fait afin de calculer par cette méthode la théorie jusqu'au premier ordre. Nous avons évité un développement consciencieux des différentes fonctions impliquées, en le remplaçant par des techniques d'analyse à simple et double harmonique.

L'entrée du programme se compose des nombres des planètes perturbantes et perturbées et du nombre de points utilisés dans l'analyse harmonique. La sortie est la représentation en séries de Fourier de la perturbation du premier ordre en coordonnées rectangulaires.

Deux approches ont été incorporées dans le programme pour résoudre les valeurs des constantes d'intégration. La première admet que les perturbations en position et vitesse sont égales à des quantités données à l'époque initiale. La seconde, suivant Brouwer et Clémence, admet que la perturbation en coordonnées z ne contient pas $\sin \ell$, $\cos \ell$ et que la perturbation en longitude ne contient pas les termes C_0 , $C_1 t$, $\sin \ell$, ou $\cos \ell$, où ℓ est l'anomalie moyenne de la planète perturbée, C_0 et C_1 sont des constantes et t est le temps depuis l'époque initiale.

Le programme a été mis en pratique pour calculer jusqu'au premier ordre la théorie de Mars, en tant que perturbé par les autres planètes. Les éléments planétaires employés par Clémence dans sa théorie de Mars ont été utilisés pour une vérification numérique de notre programme. Nos résultats s'accordent presque exactement avec ceux de Clémence.

Une autre vérification faite avec succès durant le programme fut de prouver que la représentation de Fourier de la perturbation exprime analytiquement l'équation différentielle définissant cette perturbation.

Le programme est fait de façon à pouvoir calculer les termes de plus grand ordre une fois que l'on possède les termes du premier ordre. Le programme a été mis en pratique pour calculer la théorie jusqu'au premier ordre de toutes les planètes, Pluton excepté. Les résultats de ce travail sont donnés dans ce rapport.

КОНСПЕКТ

Брувер опубликовал метод расчета возмущений в прямоугольных координатах. Этот метод является наиболее удобным и простым для доведения до высших порядков на цифровой электронной счето-решающей машине.

Была построена общая программа для вычисления теории первого порядка путем этого метода. Буквальное разложение различных необходимых функций избегалось заменой методами анализа одиночных или двойных гармоник.

Входные данные программы заключаются в числах возмущающих и возмущенных планет и в числе точек употребляемых в гармоническом анализе. Выходные данные являются изображением с помощью Фурье рядов, возмущений первого порядка в прямолинейных координатах.

Два подхода для решения постоянных интегрирования были включены в программу. В первом подходе предполагается что нарушения в положении и скорости являются равными данным величинам в начальной эпохе. Во втором, следуя Бруверу и Клемансу, предполагается что нарушения в z -координате не содержат $\sin \ell$, $\cos \ell$ а в долготе не содержат членов C_0 , $C_1 t$, $\sin \ell$ или $\cos \ell$, где ℓ является средней аномалией возмущенной планеты, C_0 и C_1 — постоянными и t является протяжением времени с начальной эпохи.

Программа употреблялась для расчета теории первого порядка Марса, как возмущенного другими планетами. Планетарные элементы употребляемые Клемансом в его теории Марса были использованы для цифровой проверки нашей программы. Наши результаты почти что точно согласуются с результатами Клеманса.

Другая проверка успешно проведенная имела целью доказательство что Фурье изображение возмущений дает аналитическое выражение дифференциального уравнения определяющего эти возмущения.

Программа построена так что она может высчитывать члены высшего порядка при доступности членов первого порядка. Программа употреблялась для расчета теории первого порядка всех планет за исключением Плутона. Результаты этих работ приводятся в этом докладе.

FIRST-ORDER PLANETARY THEORY

Perturbations in Rectangular Coordinates, Hansen's Variables, Longitude, and Distance

S. E. Hamid

1. INTRODUCTION

General planetary theory is one of the domains of celestial mechanics where the computer can play a decisive role. Unfortunately, the pioneer work of Leverrier (e.g., 1876), Newcomb (e.g., 1895), and Hill (1890) in that field, and the different analytical methods they used, cannot be conveniently developed with the present computing potentialities. In addition, pursuing that work to second-, third-, and higher-order perturbations involves intricate algebra that would be complicated for programming on the computer. It is not very surprising, therefore, that no serious attempts have been made to reexamine the work of these early pioneers in the light of present-day facilities.

Clemence (1949, 1961), however, developed a theory of Mars using Hansen's method. It is complete to the second order and includes also some of the third-order terms. From his work, which was carried out at a time when only automatic calculators were available, we can see that it is rather difficult to adapt Hansen's method for an electronic computer, especially when second- and third-order perturbations are considered.

This work was supported in part by grant NGR 09-015-002 from the National Aeronautics and Space Administration.

The challenge of producing a general planetary theory that can be developed to any order on a computer was successfully met by Brouwer (1944; Brouwer and Clemence, 1961), who evolved a very elegant method of calculating the perturbations in rectangular coordinates. This is, in my opinion, the most streamlined and adequate method to be carried to higher orders, and it is surprising that it has not received more attention. To my knowledge it has been applied just once, by Davis (1952), to the motion of Eureka, to first-order perturbations only and with the effect of only one planet on the asteroid Eureka considered.

The method was given by Brouwer up to the second order and for one perturbing planet. An extension of the method to include third-order terms and for more than one perturbing planet is obvious, and is given in Section 2. Section 3 gives, for completeness, Brouwer's solution of the problem, while Section 4 outlines the proposed approach of Brouwer's method with a digital computer. Section 5 gives the results for the first-order theory of all the planets in the solar system except Pluto.

2. DEVELOPMENT OF BROUWER'S THEORY TO THE THIRD ORDER

As a plane of reference, let us take the orbital plane of the disturbed planet at given epoch T_0 . Consider the elliptic orbit defined by the position and velocity of the disturbed planet at the epoch. We define a set of rectangular axes OX, OY, OZ with the origin O at the sun: OX is directed toward the perihelion of the elliptic orbit of the disturbed planet at the epoch, OY is in the plane of the elliptic orbit directed 90° ahead of the perihelion, and OZ is selected to form a right-hand system; i. e., it is directed toward the north pole of the plane of the elliptic orbit at the epoch.

With respect to this set of axes, the position of the disturbed planet at any time t , if all the perturbing forces are put to zero, will be simply defined through the equations of motion for the two-body problem, namely, $x_0 = r_0 \cos v_0$, $y_0 = r_0 \sin v_0$, and $z_0 = 0$, where r_0 and v_0 are the heliocentric distance and the true anomaly, respectively.

Because of the perturbation of planets, however, the position at any time t will be given by x , y , and z , where $x - x_0 = \delta x$, $y - y_0 = \delta y$, and $z = \delta z$ are quantities of the first order.

The differential equations, given by Brouwer, defining the quantities δx , δy , and δz are

$$\begin{aligned} \frac{d^2}{dt^2} \delta x + \frac{\mu}{r_0^3} \delta x - \frac{3\mu x_0}{r_0^5} (x_0 \delta x + y_0 \delta y) &= G_x, \\ \frac{d^2}{dt^2} \delta y + \frac{\mu}{r_0^3} \delta y - \frac{3\mu y_0}{r_0^5} (x_0 \delta x + y_0 \delta y) &= G_y, \\ \frac{d^2}{dt^2} \delta z + \frac{\mu}{r_0^3} \delta z &= G_z, \end{aligned} \quad (1)$$

where $\mu = k^2(1 + m)$, k being the gaussian constant and m the mass of the disturbed planet.

The quantities G_x , G_y , and G_z are given by Brouwer to the second order with the effect of one disturbing planet considered.

Let G_{1x} , G_{1y} , G_{1z} represent the parts of G_x , G_y , G_z containing the first-order terms, G_{2x} , G_{2y} , G_{2z} the second-order terms, and G_{3x} , G_{3y} , G_{3z} the third-order terms. We then have, according to Brouwer, the following expressions for G_{1x} , G_{1y} , G_{1z} and G_{2x} , G_{2y} , G_{2z} :

$$G_{1x} = \frac{\partial R_0}{\partial x_0} \quad , \quad G_{1y} = \frac{\partial R_0}{\partial y_0} \quad , \quad G_{1z} = \frac{\partial R_0}{\partial z_0} \quad . \quad (2)$$

$$\begin{aligned} G_{2x} = & \frac{\partial^2 R_0}{\partial x_0^2} \delta x + \frac{\partial^2 R_0}{\partial x_0 \partial y_0} \delta y + \frac{\partial^2 R_0}{\partial x_0 \partial z_0} \delta z \\ & + \sum_{j=1}^n \left[\frac{\partial^2 R_0}{\partial x_0 \partial x_{0j}} \delta x_j + \frac{\partial^2 R_0}{\partial x_0 \partial y_{0j}} \delta y_j + \frac{\partial^2 R_0}{\partial x_0 \partial z_{0j}} \delta z_j \right] \\ & + \mu \left[\left(\frac{9}{2} \frac{x_0}{r_0^5} - \frac{15}{2} \frac{x_0^3}{r_0^7} \right) \delta x^2 + \left(3 \frac{y_0}{r_0^5} - 15 \frac{x_0^2 y_0}{r_0^7} \right) \delta x \delta y \right. \\ & \left. + \left(3 \frac{x_0}{r_0^5} - \frac{15}{2} \frac{x_0 y_0^2}{r_0^7} \right) \delta y^2 + \frac{3}{2} \frac{x_0}{r_0^5} \delta z^2 \right] ; \end{aligned}$$

$$\begin{aligned}
G_{2y} &= \frac{\partial^2 R_0}{\partial y_0 \partial x_0} \delta x + \frac{\partial^2 R_0}{\partial y_0^2} \delta y + \frac{\partial^2 R_0}{\partial y_0 \partial z_0} \delta z \\
&+ \sum_{j=1}^n \left(\frac{\partial^2 R_0}{\partial y_0 \partial x_{0j}} \delta x_j + \frac{\partial^2 R_0}{\partial y_0 \partial y_{0j}} \delta y_j + \frac{\partial^2 R_0}{\partial y_0 \partial z_{0j}} \delta z_j \right) \\
&+ \mu \left[\left(\frac{3}{2} \frac{y_0}{r_0^5} - \frac{15}{2} \frac{x_0^2 y_0}{r_0^7} \right) \delta x^2 + \left(3 \frac{x_0}{r_0^5} - 15 \frac{x_0 y_0^2}{r_0^7} \right) \delta x \delta y \right. \\
&\quad \left. + \left(\frac{9}{2} \frac{y_0}{r_0^5} - \frac{15}{2} \frac{y_0^3}{r_0^7} \right) \delta y^2 + \frac{3}{2} \frac{y_0}{r_0^5} \delta z^2 \right] ; \\
G_{2z} &= \frac{\partial^2 R_0}{\partial z_0 \partial x_0} \delta x + \frac{\partial^2 R_0}{\partial z_0 \partial y_0} \delta y + \frac{\partial^2 R_0}{\partial z_0^2} \delta z \\
&+ \sum_{j=1}^n \left(\frac{\partial^2 R_0}{\partial z_0 \partial x_{0j}} \delta x_j + \frac{\partial^2 R_0}{\partial z_0 \partial y_{0j}} \delta y_j + \frac{\partial^2 R_0}{\partial z_0 \partial z_{0j}} \delta z_j \right) \\
&+ \mu \left(3 \frac{x_0}{r_0^5} \delta x \delta z + 3 \frac{y_0}{r_0^5} \delta y \delta z \right) . \tag{3}
\end{aligned}$$

In expressions (2) and (3), R_0 is the disturbing function, and by summation from 1 to n over j , we mean summation over the n disturbing planets. The quantities x_0 , y_0 , and z_0 are the coordinates of the disturbed planet, if we assume their unperturbed elliptic orbit at epoch T_0 , as mentioned above. Similarly, x_{0j} , y_{0j} , and z_{0j} are the coordinates of the disturbing planet j .

The quantities δx , δy , and δz are the perturbations in coordinates of the disturbed planet, while δx_j , δy_j , and δz_j are the corresponding values for the disturbing planet j .

The expression for R_0 is

$$R_0 = k^2 \sum_{j=1}^n m_j \left(\frac{1}{\rho_{0j}} - \frac{x_0 x_{0j} + y_0 y_{0j} + z_0 z_{0j}}{r_{0j}^3} \right), \quad (4)$$

where m_j is the mass of the disturbing planet j , ρ_{0j} is the mutual distance between the disturbed planet and the disturbing planet j , with their elliptic orbits assumed at epoch T_0 , and r_{0j} is the heliocentric distance of the disturbing planet j , with its unperturbed orbit assumed at epoch T_0 . We remember that x_{0j} , y_{0j} , and z_{0j} and x_j , y_j , and z_j are referred to the system of axes defined at the beginning of this section.

The expressions (2) and (3) are almost exactly reproduced from Brouwer's work, with a slight modification to include the effect of more than one perturbing planet.

Expressions of the third-order terms G_{3x} , G_{3y} , and G_{3z} can be easily obtained, following Brouwer's reasoning:

$$\begin{aligned} G_{3x} = & \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0^3} \delta x^2 + \frac{\partial^3 R_0}{\partial x_0^2 \partial y_0} \delta x \delta y + \frac{\partial^3 R_0}{\partial x_0^2 \partial z_0} \delta x \delta z \\ & + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0^2 \partial x_0} \delta y^2 + \frac{\partial^3 R_0}{\partial x_0 \partial y_0 \partial z_0} \delta y \delta z + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial z_0^2} \delta z^2 \end{aligned}$$

$$\begin{aligned}
& + \sum_{j=1}^n \left(\frac{1}{2} \frac{\partial^3 R_0}{\partial x_0^2 \partial x_{0j}} \delta x_j^2 + \frac{\partial^3 R_0}{\partial x_0 \partial x_{0j} \partial y_{0j}} \delta x_j \delta y_j + \frac{\partial^3 R_0}{\partial x_0 \partial x_{0j} \partial z_{0j}} \delta x_j \delta z_j \right. \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial y_{0j}^2} \delta y_j^2 + \frac{\partial^3 R_0}{\partial x_0 \partial y_{0j} \partial z_{0j}} \delta y_j \delta z_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial z_{0j}^2} \delta z_j^2 \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0^2 \partial x_{0j}} \delta x \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0^2 \partial y_{0j}} \delta x \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0^2 \partial z_{0j}} \delta x \delta z_j \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial y_0 \partial x_{0j}} \delta y \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial y_0 \partial y_{0j}} \delta y \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial y_0 \partial z_{0j}} \delta y \delta z_j \\
& \left. + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial x_{0j} \partial z_0} \delta z \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial y_{0j} \partial z_0} \delta z \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0 \partial z_0 \partial z_{0j}} \delta z \delta z_j \right) \\
& - \mu \left(15 \frac{x_0^2}{r_0} - \frac{35}{2} \frac{x_0^4}{r_0} - \frac{3}{2} \frac{1}{r_0} \right) \delta x^3 - \mu \left(\frac{15}{2} \frac{x_0 y_0}{r_0} - \frac{35}{2} \frac{x_0 y_0^3}{r_0} \right) \delta y^3 \\
& - \mu \left(6 \frac{1}{r_0} - \frac{105}{2} \frac{y_0^2 x_0^2}{r_0} \right) \delta y^2 \delta x - \mu \left(\frac{15}{2} \frac{x_0^2}{r_0} - \frac{3}{2} \frac{1}{r_0} \right) \delta z^2 \delta x \\
& - \mu \left(\frac{45}{2} \frac{x_0 y_0}{r_0} - \frac{105}{2} \frac{x_0^3 y_0}{r_0} \right) \delta x^2 \delta y - \mu \left(\frac{15}{2} \frac{x_0 y_0}{r_0} \right) \delta z^2 \delta y \quad . \tag{5}
\end{aligned}$$

$$\begin{aligned}
G_{3y} = & \frac{1}{2} \frac{\partial^3 R_0}{\partial x_0^2 \partial y_0} \delta x^2 + \frac{\partial^3 R_0}{\partial x_0 \partial y_0^2} \delta x \delta y + \frac{\partial^3 R_0}{\partial x_0 \partial y_0 \partial z_0} \delta x \delta z \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0^3} \delta y^2 + \frac{\partial^3 R_0}{\partial y_0^2 \partial z_0} \delta y \delta z + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial z_0^2} \delta z^2 \\
& + \sum_{j=1}^n \left(\frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial x_{0j}^2} \delta x_j^2 + \frac{\partial^3 R_0}{\partial y_0 \partial x_{0j} \partial y_{0j}} \delta x_j \delta y_j + \frac{\partial^3 R_0}{\partial y_0 \partial x_{0j} \partial z_{0j}} \delta x_j \delta z_j \right. \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial y_{0j}^2} \delta y_j^2 + \frac{\partial^3 R_0}{\partial y_0 \partial y_{0j} \partial z_{0j}} \delta y_j \delta z_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial z_{0j}^2} \delta z_j^2 \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial x_{0j} \partial x_{0j}} \delta x \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial x_{0j} \partial y_{0j}} \delta x \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial x_{0j} \partial z_{0j}} \delta x \delta z_j \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0^2 \partial x_{0j}} \delta y \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0^2 \partial y_{0j}} \delta y \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0^2 \partial z_{0j}} \delta y \delta z_j \\
& \left. + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial z_{0j} \partial x_{0j}} \delta z \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial z_{0j} \partial y_{0j}} \delta z \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0 \partial z_{0j} \partial z_{0j}} \delta z \delta z_j \right) \\
& - \mu \left(\frac{15}{2} \frac{x_0 y_0}{r_0^7} - \frac{35}{2} \frac{x_0^3 y_0}{r_0^9} \right) \delta x^3 - \mu \left(15 \frac{y_0^2}{r_0^7} - \frac{35}{2} \frac{y_0^4}{r_0^9} - \frac{3}{2} \frac{1}{r_0^5} \right) \delta y^3 \\
& - \mu \left(6 \frac{1}{r_0^5} - \frac{105}{2} \frac{x_0^2 y_0^2}{r_0^9} \right) \delta x^2 \delta y - \mu \left(\frac{45}{2} \frac{x_0 y_0}{r_0^7} - \frac{105}{2} \frac{y_0^3 x_0}{r_0^9} \right) \delta y^2 \delta x \\
& - \mu \left(\frac{15}{2} \frac{x_0 y_0}{r_0^7} \right) \delta z^2 \delta x - \mu \left(\frac{15}{2} \frac{y_0^2}{r_0^7} - \frac{3}{2} \frac{1}{r_0^5} \right) \delta z^2 \delta y \quad . \tag{6}
\end{aligned}$$

$$\begin{aligned}
G_{3z} = & \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial x_0^2} \delta x^2 + \frac{\partial^3 R_0}{\partial x_0 \partial y_0 \partial z_0} \delta x \delta y + \frac{\partial^3 R_0}{\partial x_0 \partial z_0^2} \delta x \delta z \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial y_0^2 \partial z_0} \delta y^2 + \frac{\partial^3 R_0}{\partial y_0 \partial z_0^2} \delta y \delta z + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0^3} \delta z^2 \\
& + \sum_{j=1}^n \left(\frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial x_{0j}^2} \delta x_j^2 + \frac{\partial^3 R_0}{\partial z_0 \partial x_{0j} \partial y_{0j}} \delta x_j \delta y_j + \frac{\partial^3 R_0}{\partial z_0 \partial x_{0j} \partial z_{0j}} \delta x_j \delta z_j \right. \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial y_{0j}^2} \delta y_j^2 + \frac{\partial^3 R_0}{\partial z_0 \partial y_{0j} \partial z_{0j}} \delta y_j \delta z_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial z_{0j}^2} \delta z_j^2 \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial x_{0j} \partial x_0} \delta x \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial y_{0j} \partial x_0} \delta x \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial z_{0j} \partial x_0} \delta x \delta z_j \\
& + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial x_{0j} \partial y_0} \delta y \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial y_{0j} \partial y_0} \delta y \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0 \partial z_{0j} \partial y_0} \delta y \delta z_j \\
& \left. + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0^2 \partial x_{0j}} \delta z \delta x_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0^2 \partial y_{0j}} \delta z \delta y_j + \frac{1}{2} \frac{\partial^3 R_0}{\partial z_0^2 \partial z_{0j}} \delta z \delta z_j \right) \\
& + \mu \left(\frac{3}{2} \frac{1}{r_0^5} \right) \delta z^3 - \mu \left(-\frac{3}{2} \frac{1}{r_0^5} + \frac{15}{2} \frac{x_0^2}{r_0^7} \right) \delta x^2 \delta z \\
& - \mu \left(-\frac{3}{2} \frac{1}{r_0^5} + \frac{15}{2} \frac{y_0^2}{r_0^7} \right) \delta y^2 \delta z - \mu \left(15 \frac{x_0 y_0}{r_0^7} \right) \delta x \delta y \delta z .
\end{aligned} \tag{7}$$

3. BROUWER'S SOLUTION OF THE EQUATIONS

With the above definitions of the components $G_{1x}, \dots, G_{3z}$ we have

$$\begin{aligned} G_x &= G_{1x} + G_{2x} + G_{3x} \quad , \\ G_y &= G_{1y} + G_{2y} + G_{3y} \quad , \\ G_z &= G_{1z} + G_{2z} + G_{3z} \quad . \end{aligned} \tag{8}$$

Brouwer gives the solution of the differential equations (1) in the following form:

$$\delta x = \delta_1 x + \delta_2 x \quad , \quad \delta y = \delta_1 y + \delta_2 y \quad , \quad \text{and} \quad \delta z = \delta_1 z \quad ,$$

where

$$\begin{aligned} \delta_1 x &= \int \left\{ \left[\frac{\partial x_0}{\partial \omega_0} \left(\frac{\partial x_0}{\partial L_0} \right) - \frac{\partial x_0}{\partial L_0} \left(\frac{\partial x_0}{\partial \omega_0} \right) + \frac{\partial x_0}{\partial \eta_0} \left(\frac{\partial x_0}{\partial \xi_0} \right) - \frac{\partial x_0}{\partial \xi_0} \left(\frac{\partial x_0}{\partial \eta_0} \right) \right] G_x \right. \\ &\quad \left. + \left[\frac{\partial y_0}{\partial \omega_0} \left(\frac{\partial x_0}{\partial L_0} \right) - \frac{\partial y_0}{\partial L_0} \left(\frac{\partial x_0}{\partial \omega_0} \right) + \frac{\partial y_0}{\partial \eta_0} \left(\frac{\partial x_0}{\partial \xi_0} \right) - \frac{\partial y_0}{\partial \xi_0} \left(\frac{\partial x_0}{\partial \eta_0} \right) \right] G_y \right\} dt \quad , \end{aligned}$$

$$\begin{aligned} \delta_1 y &= \int \left\{ \left[\frac{\partial x_0}{\partial \omega_0} \left(\frac{\partial y_0}{\partial L_0} \right) - \frac{\partial x_0}{\partial L_0} \left(\frac{\partial y_0}{\partial \omega_0} \right) + \frac{\partial x_0}{\partial \eta_0} \left(\frac{\partial y_0}{\partial \xi_0} \right) - \frac{\partial x_0}{\partial \xi_0} \left(\frac{\partial y_0}{\partial \eta_0} \right) \right] G_x \right. \\ &\quad \left. + \left[\frac{\partial y_0}{\partial \omega_0} \left(\frac{\partial y_0}{\partial L_0} \right) - \frac{\partial y_0}{\partial L_0} \left(\frac{\partial y_0}{\partial \omega_0} \right) + \frac{\partial y_0}{\partial \eta_0} \left(\frac{\partial y_0}{\partial \xi_0} \right) - \frac{\partial y_0}{\partial \xi_0} \left(\frac{\partial y_0}{\partial \eta_0} \right) \right] G_y \right\} dt \quad , \end{aligned}$$

$$\delta_2 x = -3 \mu^2 L_0^{-4} \frac{\partial x_0}{\partial \omega_0} \iint \left(\frac{\partial x_0}{\partial \omega_0} G_x + \frac{\partial y_0}{\partial \omega_0} G_y \right) dt dt \quad ,$$

$$\delta_2 y = -3 \mu^2 L_0^{-4} \frac{\partial y_0}{\partial \omega_0} \iint \left(\frac{\partial x_0}{\partial \omega_0} G_x + \frac{\partial y_0}{\partial \omega_0} G_y \right) dt dt \quad ,$$

$$\begin{aligned} \delta_1 z = & \sqrt{\frac{a^3 n}{\mu}} \sin E \int \sqrt{\frac{a^3 n}{\mu}} (\cos E - e) G_z dt - \sqrt{\frac{a^3 n}{\mu}} (\cos E - e) \\ & \times \int \sqrt{\frac{a^3 n}{\mu}} \sin E G_z dt \quad . \end{aligned} \quad (9)$$

The quantities enclosed between double parentheses in the integrand in the above expressions are assumed to be constants during the process of integration.

For convenience, the definitions of the terms in equations (9) are taken from Brouwer and Clemence (1961, pp. 398-414):

$$\frac{\partial x_0}{\partial \omega_0} = \frac{\partial x_0}{\partial \ell} \quad ,$$

$$\frac{\partial y_0}{\partial \omega_0} = \frac{\partial y_0}{\partial \ell} \quad ,$$

$$\frac{\partial x_0}{\partial L_0} = \frac{1}{na} \left[2 \frac{\partial x_0}{\partial a} - \frac{\cos \phi \tan (\phi/2)}{a} \frac{\partial x_0}{\partial e} \right] \quad ,$$

$$\frac{\partial y_0}{\partial L_0} = \frac{1}{na} \left[2 \frac{\partial y_0}{\partial a} - \frac{\cos \phi \tan (\phi/2)}{a} \frac{\partial y_0}{\partial e} \right] \quad ,$$

$$\frac{\partial x_0}{\partial \xi_0} = \frac{a}{(\mu a)^{1/4}} \frac{\cos \phi}{a \cos (\phi/2)} \frac{\partial x_0}{\partial e} \quad ,$$

$$\frac{\partial y_0}{\partial \xi_0} = (\mu a)^{1/4} \frac{\cos \phi}{\cos (\phi/2)} \frac{\partial y_0}{\partial e} ,$$

$$\frac{\partial x_0}{\partial \eta_0} = (\mu a)^{1/4} \frac{1}{2 \sin (\phi/2)} \left(\frac{\partial x_0}{\partial \ell} - \frac{\partial x_0}{\partial \tilde{\omega}} \right) ,$$

$$\frac{\partial y_0}{\partial \eta_0} = (\mu a)^{1/4} \frac{1}{2 \sin (\phi/2)} \left(\frac{\partial y_0}{\partial \ell} - \frac{\partial y_0}{\partial \tilde{\omega}} \right) ,$$

where

$$L_0 = \sqrt{\mu a} ,$$

a, n = semimajor axis and mean motion of the perturbed planet, at initial epoch,

$e = \sin \phi$ = eccentricity of the perturbed planet, at initial epoch,

$$\mu = n^2 a^3 ,$$

ℓ = mean anomaly,

$$\frac{\partial x_0}{\partial e} = -a \left(1 + \frac{a}{r_0} \sin^2 E \right) ,$$

$$\frac{\partial y_0}{\partial e} = a \left[-\frac{e}{\cos \phi} \sin E + \frac{a}{r_0} \cos \phi \sin E \cos E \right] ,$$

$$\frac{\partial x_0}{\partial a} = \cos E - e , \quad \frac{\partial y_0}{\partial a} = \cos \phi \sin E , \quad \frac{\partial x_0}{\partial \ell} = -\frac{a^2}{r_0} \sin E ,$$

$$\frac{\partial y_0}{\partial \ell} = \frac{a^2 \cos \phi}{r_0} \cos E , \quad \frac{\partial x_0}{\partial \tilde{\omega}} = -y_0 , \quad \frac{\partial y_0}{\partial \tilde{\omega}} = +x_0 ,$$

E, r_0 being, respectively, the eccentric anomaly and the heliocentric distance of the perturbed planet, based on its elements at initial epoch.

4. THE SUGGESTED DIGITAL COMPUTER APPROACH

4.1 Definitions

We define the following quantities:

$$F_{11} = \int \left(\frac{\partial x_0}{\partial \omega_0} G_x + \frac{\partial y_0}{\partial \omega_0} G_y \right) dt \quad ,$$

$$F_{12} = \int \left(\frac{\partial x_0}{\partial L_0} G_x + \frac{\partial y_0}{\partial L_0} G_y \right) dt \quad ,$$

$$F_{13} = \int \left(\frac{\partial x_0}{\partial \eta_0} G_x + \frac{\partial y_0}{\partial \eta_0} G_y \right) dt \quad ,$$

$$F_{14} = \int \left(\frac{\partial x_0}{\partial \xi_0} G_x + \frac{\partial y_0}{\partial \xi_0} G_y \right) dt \quad ; \tag{10}$$

$$F_{21} = \iint \left(\frac{\partial x_0}{\partial \omega_0} G_x + \frac{\partial y_0}{\partial \omega_0} G_y \right) dt \, dt \quad ; \tag{11}$$

$$q_1 = \sqrt{\frac{a^3 n}{\mu}} (\cos E - e) \quad , \quad q_2 = \sqrt{\frac{a^3 n}{\mu}} \sin E \quad ; \tag{12}$$

$$F_{31} = \int q_1 G_z \, dt \quad ,$$

$$F_{32} = \int q_2 G_z \, dt \quad . \tag{13}$$

With the above definitions we can now write equations (9) as

$$\begin{aligned}
\delta_1 x &= \frac{\partial x_0}{\partial L_0} F_{11} - \frac{\partial x_0}{\partial \omega_0} F_{12} + \frac{\partial x_0}{\partial \xi_0} F_{13} - \frac{\partial x_0}{\partial \eta_0} F_{14} \quad , \\
\delta_2 x &= -3 \mu^2 L_0^{-4} \frac{\partial x_0}{\partial \omega_0} F_{21} \quad , \\
\delta_1 y &= \frac{\partial y_0}{\partial L_0} F_{11} - \frac{\partial y_0}{\partial \omega_0} F_{12} + \frac{\partial y_0}{\partial \xi_0} F_{13} - \frac{\partial y_0}{\partial \eta_0} F_{14} \quad , \\
\delta_2 y &= -3 \mu^2 L_0^{-4} \frac{\partial y_0}{\partial \omega_0} F_{21} \quad , \\
\delta_1 z &= q_2 F_{31} - q_1 F_{32} \quad .
\end{aligned} \tag{14}$$

Equations (10) to (14) are, in fact, another representation of Brouwer's solution.

4.2 The First-Order Theory

To carry out the solutions of equations (14) on a digital computer, we note that G_x , G_y , G_z are functions of δx , δy , δz . However, if we start with the first-order theory, then G_x , G_y , G_z will be independent of δx , δy , δz . This is seen at once from the definitions of G_{1x} , G_{1y} , G_{1z} .

Therefore, as a first approximation, we put

$$G_x = G_{1x} \quad , \quad G_y = G_{1y} \quad , \quad \text{and} \quad G_z = G_{1z} \quad . \tag{15}$$

Also, it will be understood that whenever we refer to perturbations, we mean first-order perturbations, arising from the above definition of G_x , G_y , G_z .

To be more specific, and for the convenience of presentation, we shall consider the disturbed planet to be Mars. The expressions for G_{1x} , G_{1y} , G_{1z} are the summations of the effects of the various planets upon Mars.

This means that δx , δy , δz are composed of different parts, each part corresponding to the effect of a given planet on Mars, and therefore dependent on the mean anomalies of Mars and that planet.

In fact, if we denote by $\delta x_4(k, 4)$, $\delta y_4(k, 4)$, $\delta z_4(k, 4)$ the perturbations of planet k on the rectangular coordinates of Mars, and by δx_4 , δy_4 , δz_4 the perturbations of the rectangular coordinates of Mars arising from all the planets, then we have

$$\begin{aligned}\delta x_4 &= \sum_{k=1}^n \delta x_4(k, 4) \quad , \\ \delta y_4 &= \sum_{k=1}^n \delta y_4(k, 4) \quad , \\ \delta z_4 &= \sum_{k=1}^n \delta z_4(k, 4) \quad ,\end{aligned}\tag{16}$$

where it is obvious that $k \neq 4$. We note that $\delta x_4(k, 4)$, $\delta y_4(k, 4)$, $\delta z_4(k, 4)$ can be evaluated separately for given k . In fact, as long as we restrict ourselves to first-order theory, the differential equations (1) defining the perturbation in rectangular coordinates can be rewritten for each disturbing planet.

For example, the equations defining the first-order perturbation of planet k on Mars are the following:

$$\begin{aligned}\frac{d^2 \delta x_4(k, 4)}{dt^2} + \frac{\mu}{r_0^3} \delta x_4(k, 4) - \frac{3\mu x_0}{r_0^5} [x_0 \delta x_4(k, 4) + y_0 \delta y_4(k, 4)] &= G_{1x}(k, 4) \quad , \\ \frac{d^2 \delta y_4(k, 4)}{dt^2} + \frac{\mu}{r_0^3} \delta y_4(k, 4) - \frac{3\mu y_0}{r_0^5} [x_0 \delta x_4(k, 4) + y_0 \delta y_4(k, 4)] &= G_{1y}(k, 4) \quad ,\end{aligned}$$

$$\frac{d^2 \delta z_4(k, 4)}{dt^2} + \frac{\mu}{r_0^3} \delta z_4(k, 4) = G_{1z}(k, 4) \quad . \quad (17)$$

In the definitions of $G_{1x}(k, 4)$, $G_{1y}(k, 4)$, $G_{1z}(k, 4)$, we consider only the disturbing force of planet k on Mars.

From the above discussion it can be seen that the solution of equations (17) can be expressed as follows:

$$\begin{aligned} \delta x_4(k, 4) &= \frac{\partial x_0}{\partial L_0} F_{11}(k, 4) - \frac{\partial x_0}{\partial \omega_0} F_{12}(k, 4) + \frac{\partial x_0}{\partial \xi_0} F_{13}(k, 4) \\ &\quad - \frac{\partial x_0}{\partial \eta_0} F_{14}(k, 4) - 3\mu^2 L_0^{-4} \frac{\partial x_0}{\partial \omega_0} F_{21}(k, 4) \quad , \\ \delta y_4(k, 4) &= \frac{\partial y_0}{\partial L_0} F_{11}(k, 4) - \frac{\partial y_0}{\partial \omega_0} F_{12}(k, 4) + \frac{\partial y_0}{\partial \xi_0} F_{13}(k, 4) \\ &\quad - \frac{\partial y_0}{\partial \eta_0} F_{14}(k, 4) - 3\mu^2 L_0^{-4} \frac{\partial y_0}{\partial \omega_0} F_{21}(k, 4) \quad , \\ \delta z_4(k, 4) &= q_2 F_{31}(k, 4) - q_1 F_{32}(k, 4) \quad . \end{aligned} \quad (18)$$

Considering the F terms in equations (18), let us take, for example $F_{11}(k, 4)$, which is defined by the equation

$$F_{11}(k, 4) = \int \left(\frac{\partial x_0}{\partial \omega_0} G_{1x}(k, 4) + \frac{\partial y_0}{\partial \omega_0} G_{1y}(k, 4) \right) dt \quad .$$

The integrand in the above expression can be represented by a Fourier series in the two arguments ℓ_k , ℓ_4 , the mean anomalies of the planet k and Mars, respectively. The Fourier series can be obtained on a purely numerical basis by computing the special values of the integrand for different combinations of ℓ_k , ℓ_4 .

Once we have double-harmonic representation for that integrand, we can easily carry out the integration and obtain a trigonometric series expression for $F_{11}(k, 4)$. This series will be composed of three parts:

1. The secular part is a constant number multiplied by time t , measured from initial epoch, and denoted by S_{011} .
2. The periodic part is a Fourier series with arguments ℓ_k, ℓ_4 , and is denoted by $P_{11}(k, 4)$.
3. The third part is the constant of integration, whose value has not yet been obtained and which we denote by C_{11} .

We can similarly define $F_{12}(k, 4), F_{13}(k, 4), F_{14}(k, 4), F_{31}(k, 4), F_{32}(k, 4)$ with the corresponding quantities $S_{012}, S_{013}, S_{014}, S_{031}, S_{032}$ for the secular parts, $P_{12}(k, 4), P_{13}(k, 4), P_{14}(k, 4), P_{31}(k, 4), P_{32}(k, 4)$ for the periodic parts, and $C_{12}, C_{13}, C_{14}, C_{31}, C_{32}$ for the constants of integration.

For the function $F_{21}(k, 4)$ the situation is slightly different because it implies double integration. It can be seen, however, that the secular part of this function will not contain terms with coefficient t^2 . There will be two constants of integration. The first one, C_{11} , already defined, appears in the secular part of the function, and the second is denoted by C_{20} . This means that the secular part S_{021} will simply be $C_{11}t$.

In accordance with the previous notation, we let the periodic part of the function $F_{21}(k, 4)$ be $P_{21}(k, 4)$, which can be obtained similarly as $P_{11}(k, 4), P_{12}(k, 4), \dots$. Hence, we can express the terms $\delta x_4(k, 4), \delta y_4(k, 4), \delta z_4(k, 4)$ as follows:

$$\begin{aligned} \delta x_4(k, 4) = & S_x(k, 4)t + P_x(k, 4) + C_{11} \frac{\partial x_0}{\partial L_0} - (C_{12} + C_{20} 3\mu^2 L_0^{-4}) \frac{\partial x_0}{\partial \omega_0} \\ & + C_{13} \frac{\partial x_0}{\partial \xi_0} - C_{14} \frac{\partial x_0}{\partial \eta_0} - C_{11} 3\mu^2 L_0^{-4} \frac{\partial x_0}{\partial \omega_0} t, \end{aligned}$$

$$\begin{aligned}
\delta y_4(k, 4) = & S_y(k, 4)t + P_y(k, 4) + C_{11} \frac{\partial y_0}{\partial L_0} - (C_{12} + C_{20} 3\mu^2 L_0^{-4}) \frac{\partial y_0}{\partial \omega_0} \\
& + C_{13} \frac{\partial y_0}{\partial \xi_0} - C_{14} \frac{\partial y_0}{\partial \eta_0} - C_{11} 3\mu^2 L_0^{-4} \frac{\partial y_0}{\partial \omega_0} t \quad , \\
\delta z_4(k, 4) = & S_z(k, 4)t + P_z(k, 4) + C_{31} q_2 - C_{32} q_1 \quad , \tag{19}
\end{aligned}$$

where

$$\begin{aligned}
S_x(k, 4) = & S_{011} \frac{\partial x_0}{\partial L_0} - S_{012} \frac{\partial x_0}{\partial \omega_0} + S_{013} \frac{\partial x_0}{\partial \xi_0} - S_{014} \frac{\partial x_0}{\partial \eta_0} \quad , \\
S_y(k, 4) = & S_{011} \frac{\partial y_0}{\partial L_0} - S_{012} \frac{\partial y_0}{\partial \omega_0} + S_{013} \frac{\partial y_0}{\partial \xi_0} - S_{014} \frac{\partial y_0}{\partial \eta_0} \quad , \\
S_z(k, 4) = & S_{031} q_2 - S_{032} q_1 \quad , \\
P_x(k, 4) = & P_{11}(k, 4) \frac{\partial x_0}{\partial L_0} - P_{12}(k, 4) \frac{\partial x_0}{\partial \omega_0} + P_{13}(k, 4) \frac{\partial x_0}{\partial \xi_0} \\
& - P_{14}(k, 4) \frac{\partial x_0}{\partial \eta_0} - 3\mu^2 L_0^{-4} \frac{\partial x_0}{\partial \omega_0} P_{21}(k, 4) \quad , \\
P_y(k, 4) = & P_{11}(k, 4) \frac{\partial y_0}{\partial L_0} - P_{12}(k, 4) \frac{\partial y_0}{\partial \omega_0} + P_{13}(k, 4) \frac{\partial y_0}{\partial \xi_0} \\
& - P_{14}(k, 4) \frac{\partial y_0}{\partial \eta_0} - 3\mu^2 L_0^{-4} \frac{\partial y_0}{\partial \omega_0} P_{21}(k, 4) \quad , \\
P_z(k, 4) = & P_{31}(k, 4) q_2 - P_{32}(k, 4) q_1 \quad . \tag{20}
\end{aligned}$$

Since the S 's and P 's appearing as coefficients in the right-hand side of the above definitions are obtained by harmonic analysis and integration of the harmonic series, we can compute the special values of S_x, S_y, S_z , and P_x, P_y, P_z for any combination of ℓ_4, ℓ_k . This will enable us to obtain harmonic representations for S_x, S_y, S_z and P_x, P_y, P_z . We still have to determine the numerical values of the constants of integration, C , in order to get complete harmonic representations for $\delta x_4(k, 4), \delta y_4(k, 4), \delta z_4(k, 4)$.

For the evaluation of the C 's, we note that the constants C_{12} and C_{20} always occur in the combination $C_{12} + C_{20} 3\mu_0 L_0^{-4}$. This means that they can be replaced by one constant. For convenience of notation, we denote that constant by C_{12} . The constants of integration to be evaluated are now the following: $C_{11}, C_{12}, C_{13}, C_{14}, C_{31}, C_{32}$.

There are two approaches to the evaluation of the constants of integration:

1. The first approach follows the procedure of Brouwer and Clemence (1961) and defines the C 's so that

- a. the perturbation δz will not contain the terms $\sin \ell_4, \cos \ell_4$: this will define C_{31}, C_{32} ;
- b. the perturbations $\delta x, \delta y$ are such that the perturbations in longitude, $\delta v = (x_0 \delta y - y_0 \delta x)/r_0^2$, will not contain constant terms, or terms with coefficient t , or the terms $\sin \ell_4, \cos \ell_4$: this will define the constants $C_{11}, C_{12}, C_{13}, C_{14}$.

In this approach we are taking mean elements of the planets as the starting reference elements at the initial epoch.

2. The second approach is to put the conditions that, at initial epoch $t = 0$, the perturbations in position and velocity are equal to given values. These values will depend on whether we had started with mean or the osculating elements. In the latter case, we must take these values to be zero. In the former case, we can take these values to be the difference

between the position and the velocity as given by the mean elements and the actual osculating elements at $t = 0$. These osculating elements, if not already available, can be obtained by numerical integration. In this approach, when we consider the higher-order perturbations, the constants of integration will be such that these higher-order perturbations in position and velocity will vanish at $t = 0$.

Both the first and second approaches can be carried out easily with the digital computer. To outline the digital computer program used in the evaluation of the constants of integration in the first approach, we let $C_0\{F\}$, $C_1\{F\}$, $S_1\{F\}$ denote, respectively, the constant term, the coefficient of $\cos \ell_4$, and $\sin \ell_4$ of the Fourier series representing the function F . The constants C_{31} , C_{32} are then obtained from the following two equations:

$$\begin{aligned} C_1\{P_z(k, 4)\} + C_{31} C_1\{q_2\} - C_{32} C_1\{q_1\} &= 0 \quad , \\ S_1\{P_z(k, 4)\} + C_{31} S_1\{q_2\} - C_{32} S_1\{q_1\} &= 0 \quad . \end{aligned} \quad (21)$$

The constant C_{11} is given by the following equation:

$$\begin{aligned} C_0 \left\{ \frac{x_0}{r_0^2} S_y(k, 4) - \frac{y_0}{r_0^2} S_x(k, 4) \right\} \\ - 3\mu^2 L_0^{-4} C_{11} C_0 \left\{ \frac{x_0}{r_0^2} \frac{\partial y_0}{\partial \omega_0} - \frac{y_0}{r_0^2} \frac{\partial x_0}{\partial \omega_0} \right\} = 0 \quad . \end{aligned} \quad (22)$$

The constants C_{12} , C_{13} , C_{14} are determined from three equations, the first of which is

$$C_0 \left\{ \frac{x_0}{r_0^2} P_y(k, 4) - \frac{y_0}{r_0^2} P_x(k, 4) \right\} + C_{11} C_0 \left\{ \frac{x_0}{r_0^2} \frac{\partial y_0}{\partial L_0} - \frac{y_0}{r_0^2} \frac{\partial x_0}{\partial L_0} \right\}$$

$$\begin{aligned}
& -C_{12} C_0 \left\{ \frac{x_0}{r_0^2} \frac{\partial y_0}{\partial \omega_0} - \frac{y_0}{r_0^2} \frac{\partial x_0}{\partial \omega_0} \right\} + C_{13} C_0 \left\{ \frac{x_0}{r_0^2} \frac{\partial y_0}{\partial \xi_0} - \frac{y_0}{r_0^2} \frac{\partial x_0}{\partial \xi_0} \right\} \\
& -C_{14} C_0 \left\{ \frac{x_0}{r_0^2} \frac{\partial y_0}{\partial \eta_0} - \frac{y_0}{r_0^2} \frac{\partial x_0}{\partial \eta_0} \right\} = 0 \quad . \quad (23)
\end{aligned}$$

The other two equations are exactly like the above equation but with C_1 replacing C_0 for the second and S_1 replacing C_0 for the third.

Note that the numerical values of $C_0\{F\}$, $C_1\{F\}$, $S_1\{F\}$ of the various F functions given in equations (21) to (23) can be evaluated from harmonic analysis of these functions. In the functions $P_x(k, 4)$, $P_y(k, 4)$, $P_z(k, 4)$, we are only interested in the parts that do not contain the mean anomaly ℓ_k . These parts have already been derived in our previous analysis.

The second approach for the evaluation of the constants of integration is more straightforward. We let δx_0 , δy_0 , δz_0 , $\delta \dot{x}_0$, $\delta \dot{y}_0$, $\delta \dot{z}_0$ be the values of perturbations in position and velocity at $t = 0$. If we put

$$\begin{aligned}
a_{11x} &= \frac{\partial x_0}{\partial L_0} \quad , \quad a_{12x} = -\frac{\partial x_0}{\partial \omega_0} \quad , \quad a_{13x} = \frac{\partial x_0}{\partial \xi_0} \quad , \quad a_{14x} = -\frac{\partial x_0}{\partial \eta_0} \quad , \\
a_{21x} &= -3\mu^2 L_0^{-4} \frac{\partial x_0}{\partial \omega_0} \quad , \\
a_{11y} &= \frac{\partial y_0}{\partial L_0} \quad , \quad a_{12y} = -\frac{\partial y_0}{\partial \omega_0} \quad , \quad a_{13y} = \frac{\partial y_0}{\partial \xi_0} \quad , \quad a_{14y} = -\frac{\partial y_0}{\partial \eta_0} \quad , \\
a_{21y} &= -3\mu^2 L_0^{-4} \frac{\partial y_0}{\partial \omega_0} \quad , \quad (24) \\
a_{31z} &= q_2 \quad , \quad a_{32z} = -q_1
\end{aligned}$$

then we have

$$\begin{aligned}
C_{11} a_{11x} + C_{12} a_{12x} + C_{13} a_{13x} + C_{14} a_{14x} &= \delta x_0 - P_x(k, 4) , \\
C_{11} a_{11y} + C_{12} a_{12y} + C_{13} a_{13y} + C_{14} a_{14y} &= \delta y_0 - P_y(k, 4) , \\
C_{11}(\dot{a}_{11x} + a_{21x}) + C_{12} \dot{a}_{12x} + C_{13} \dot{a}_{13x} + C_{14} \dot{a}_{14x} &= \delta \dot{x}_0 - \dot{P}_x(k, 4) - S_x(k, 4) , \\
C_{11}(\dot{a}_{11y} + a_{21y}) + C_{12} \dot{a}_{12y} + C_{13} \dot{a}_{13y} + C_{14} \dot{a}_{14y} &= \delta \dot{y}_0 - \dot{P}_y(k, 4) - S_y(k, 4) , \\
C_{31} a_{31z} + C_{32} a_{32z} &= \delta z_0 - P_z(k, 4) , \\
C_{32} \dot{a}_{31z} + C_{32} \dot{a}_{32z} &= \delta \dot{z}_0 - \dot{P}_z(k, 4) - S_z(k, 4) .
\end{aligned}
\tag{25}$$

In the above set of equations, the dots on the various terms denote time derivatives of these terms.

It is understood that the coefficients of the C's in the left-hand sides and the quantities in the right-hand sides of equations (25) are evaluated at $t = 0$, initial epoch. The evaluation of the time derivatives of the various functions involved can be directly derived analytically, since we already have the harmonic representations of these functions in terms of the mean anomalies ℓ_k, ℓ_4 .

With the evaluation of the constants of integration, the solution of the first-order theory is completed. A computer program to carry out this solution by the above-mentioned method has been constructed and successfully tested. The elements of all the planets were put into the program to make it as general as possible. To apply the program, we need only the sequence number k of the perturbed planet, the sequence number j of the perturbing planet, the number of points used in computing the special values of the various functions for harmonic analysis, and a code 1 or 2 defining the approach that will be used for computing the constants of integration. If we use the second approach, we need the initial values of perturbations in position and velocity as input.

The final output of the program is the harmonic representation of both the secular and periodic parts of $\delta x_k(j,k)$, $\delta y_k(j,k)$, and $\delta z_k(j,k)$ and their special values that were used to derive the harmonic representations. It will be mainly these special values, and not the harmonic representations, that we shall need when we proceed further to compute second- and higher-order terms of perturbation.

4.3 Comparison with the Work of Clemence

I have compared the above approach to Brouwer's theory with Clemence's (1949) work on the theory of Mars. Clemence's work is considered a milestone in the theory of planetary motion. For the first time we have available a detailed and accurate computation of general perturbations on a given planet to various orders. We can confidently compare my results with those of Clemence. In fact, through such a comparison, I was able to debug my program at several stages and feel satisfied with the results.

Starting with Clemence's elements, I have applied the above approach for Mars, and also for all perturbing planets from Mercury to Neptune. The constants of integration had been evaluated according to the first approach, given in the previous section.

The harmonic representation of $\delta z_4(k, 4)$ for the different planets k can be compared directly with Clemence's series of $u/\cos i$. The relation between δz and $u/\cos i$ is given by $\delta z/a = u/\cos i$, where a is the semimajor axis of the perturbed planet, which in this case is Mars. That comparison has been carried out, and almost complete agreement was found for both the secular and the periodic parts. This means that my representation of δz is correct.

In order to check δx and δy , I obtained the harmonic representation of the periodic perturbation in longitude (δv) and in $\log r$ from the following relation:

$$\delta \log r = \frac{\sqrt{(x_0 + \delta x_4(k, 4))^2 + (y_0 + \delta y_4(k, 4))^2 + \delta z_4(k, 4)^2}}{\sqrt{x_0^2 + y_0^2}} - 1$$

$$\delta v = \tan^{-1} \frac{y_0 + \delta y_4(k, 4)}{x_0 + \delta x_4(k, 4)} - \tan^{-1} \frac{y_0}{x_0} ,$$

where $\delta x_4(k, 4)$, $\delta y_4(k, 4)$ are limited to their periodic parts. In fact, I derived special values of δv and $\delta \log r$ for different combinations of ℓ_k , ℓ_4 by using the already determined special values of the periodic parts of $\delta y_4(k, 4)$, $\delta x_4(k, 4)$. From these special values of δv and $\delta \log r$, a harmonic representation was obtained and found to be in almost exact agreement with Clemence's derivation.

From the periodic perturbations $\delta x_4(k, 4)$, $\delta y_4(k, 4)$, $\delta z_4(k, 4)$, we can again compute the perturbations $n_4 \delta t(k, 4)$, $v_4(k, 4)$ defined in Hansen's method. This is done by the following reasoning: For the given value of the mean anomaly ℓ_k of the disturbing planet, and ℓ_4 of Mars, we can compute the perturbations $\delta x_4(k, 4)$, $\delta y_4(k, 4)$, $\delta z_4(k, 4)$, which will enable us to compute the perturbed coordinates x_4 , y_4 , z_4 . From x_4 , y_4 we compute the perturbed true anomaly v_4 given by $v_4 = \tan^{-1} y_4/x_4$. From the perturbed true anomaly v_4 , we compute the corresponding mean anomaly M and the heliocentric distance r , using the unperturbed values as the semimajor axis and eccentricity of the disturbed planet. These values are given in Section 5. The values of $n_4 \delta t(k, 4)$ and $v_4(k, 4)$ will be given by

$$n_4 \delta t(k, 4) = M - \ell_4$$

$$v_4(k, 4) = \frac{\sqrt{x_4^2 + y_4^2 + z_4^2}}{r} - 1 .$$

This means that for each combination of ℓ_k , ℓ_4 , we can obtain the special values $n_4 \delta t(k, 4)$, $v_4(k, 4)$. From these sets of special values, corresponding to different values of ℓ_k , ℓ_4 , we can obtain a double-harmonic representation of the Hansen variables $n \delta t$, v . Similar reasoning can be applied to the secular perturbation in $n \delta t$, v . In this case, however, only single-harmonic analysis is needed.

The harmonic representations of $n\delta t$, and v , both periodic and secular, have been obtained for the perturbations of different planets on Mars and have been compared with Clemence's results. Almost exact agreement has been found.

4.4 Analytical Comparison

Another, more rigorous and consistent check can be carried out from the following consideration. Our program gives us the harmonic representations of the secular parts $S_x(k, 4)$, $S_y(k, 4)$, $S_z(k, 4)$ and the periodic parts $P_x(k, 4)$, $P_y(k, 4)$, $P_z(k, 4)$ of the perturbations $\delta x_4(k, 4)$, $\delta y_4(k, 4)$, $\delta z_4(k, 4)$. These parts must identically satisfy the differential equations defining the perturbations in δx , δy , δz . Hence, we require the following identities:

$$\frac{d^2 S_x(k, 4)}{dt^2} \equiv -\frac{\mu}{r_0^3} S_x(k, 4) + \frac{3\mu x_0}{r_0^5} [x_0 S_x(k, 4) + y_0 S_y(k, 4)] ,$$

$$\frac{d^2 S_y(k, 4)}{dt^2} \equiv -\frac{\mu}{r_0^3} S_y(k, 4) + \frac{3\mu y_0}{r_0^5} [x_0 S_x(k, 4) + y_0 S_y(k, 4)] ,$$

$$\frac{d^2 S_z(k, 4)}{dt^2} \equiv -\frac{\mu}{r_0^3} S_z(k, 4) ,$$

$$\begin{aligned} \frac{d^2 P_x(k, 4)}{dt^2} \equiv & -\frac{\mu}{r_0^3} P_x(k, 4) + \frac{3\mu x_0}{r_0^5} (x_0 P_x(k, 4) + y_0 P_y(k, 4)) + G_{1x}(k, 4) \\ & - 2 \dot{S}_x(k, 4) , \end{aligned}$$

$$\frac{d^2 P_y(k, 4)}{dt^2} \equiv - \frac{\mu}{r_0} P_y(k, 4) + \frac{3\mu y_0}{r_0} [x_0 P_x(k, 4) + y_0 P_y(k, 4) + G_{ly}(k, 4)]$$

$$- 2 \dot{S}_y(k, 4) \quad ,$$

$$\frac{d^2 P_z(k, 4)}{dt^2} \equiv - \frac{\mu}{r_0} P_z(k, 4) + G_{lz}(k, 4) - 2 \dot{S}_z(k, 4) \quad .$$

The left-hand members of the above identities can be derived from our harmonic representations of $S_x(k, 4), \dots, P_z(k, 4)$, which give another set of harmonic representations for $\dot{S}_x(k, 4), \dots, \dot{P}_z(k, 4)$. The right-hand members of the above identities can be expressed by harmonic representations. In deriving these representations, the special values of $P_x(k, 4)$, $P_y(k, 4)$, $P_z(k, 4)$, already obtained in our analysis, were used. To get the special values of $\dot{S}_x(k, 4)$, $\dot{S}_y(k, 4)$, $\dot{S}_z(k, 4)$, the derivatives of the harmonic representations of $S_x(k, 4)$, $S_y(k, 4)$, $S_z(k, 4)$ were used. The harmonic representations of the right-hand sides of the above six identities were compared with the harmonic representations of the left-hand sides. A very satisfactory agreement was found.

5. RESULTS

The orbital elements and mass of the planets used in the computation are those given by Clemence in his theory of Mars. The epoch of time is 1850 Jan. 0, corresponding to Julian Ephemeris Day 2396758.0. For the sake of convenience, these orbital elements and masses are included in Table 1.

The number of points considered in the harmonic analysis varies from one case to another. We note that to carry the double-harmonic analysis for a given function such that for the argument $j\ell_1 \pm k\ell_0$ the integers j and k take the values $0 \rightarrow n$, we need to consider the $2n + 1$ equidistant values of both ℓ_1 and ℓ_0 given by $2\pi/2n + 1 \cdot i$, $i = 0 \rightarrow 2n$. This will involve the computation of $(2n + 1)^2$ special values of the given function corresponding to the different combinations of ℓ_1 , ℓ_0 .

Table 2 gives the values of n used in the evaluation of the periodic perturbations in the different cases.

In deciding the value of n , we were guided by the final results of the works of Newcomb (1895), Hill (1890), and Clemence (1949). In these works, the range of the integers j and k in the argument $j\ell_1 \pm k\ell_0$, which appears in their double-harmonic representations, will serve as a lower limit to the adopted values of n for the case under consideration. The adopted values of n for the different cases in the theory of Mars proved to be adequate, when we consider the excellent agreement that we found between our results and those of Clemence. The best procedure, however, for obtaining the value of n is to try different increasing values for each case and to compare the results in each trial until we arrive at the trial where the result will not change further. This may involve more than two trials for each case. For the present, we are satisfied with the more intuitive approach taken in the present analysis.

Table 1. Adopted planetary elements

Planet	n	e	π	ϵ_0	i	θ	a^*	Mass	a^{**}
Mercury	5381016.3893	0.20560396	75°07'19".37	323°11'23".53	7°00' 7".00	46°33'12".24	0.387098595	1.7×10^{-7}	0.3870986713
Venus	2106641.4171	0.00684458	129°27'34.5	243°57'44.19	3°23'35.26	75°19'47.41	0.723331617	2.45×10^{-6}	0.7233322169
Earth	1295977.4496	0.01677126	100°21'36.30	99°48'18.56	0°00'00.00	---	1.000000021	3.04×10^{-6}	1.000000021
Mars	689050.9354	0.09326685	333°17'52.37	83°09'16.06	1°51'02.42	48°24'03.40	1.523688380	3.2×10^{-7}	1.5236914428
Jupiter	109256.63954	0.04825382	11°54'26.72	159°56'25.05	1°18'41.81	98°55'58.16	5.202755032	9.54786×10^{-4}	5.202803945
Saturn	43996.20414	0.05606075	90°06'39.53	14°49'39.95	2°29'39.26	112°20'51.38	9.54285512	2.85584×10^{-4}	9.538843653
Uranus	15426.0928	0.0469055	168°15'46.9	28°25'17.43	0°46'20.54	73°14'08.0	19.1909792	4.3727×10^{-5}	19.18228185
Neptune	7864.698	0.0085082	43°19'43.7	335°05'38.91	1°47'01.81	130°08'00.2	30.070947	5.1776×10^{-5}	30.057342

* This is the corrected mean distance obtained by applying the constant part of the perturbations by other planets to a.

** This unperturbed value of mean distance is based on the relation $a^3 n^2 = k^2 (1 + m)$.

Table 2. Adopted values of n used in the harmonic analysis

Disturbed planet	Disturbing planet							
	1 Mercury	2 Venus	3 Earth	4 Mars	5 Jupiter	6 Saturn	7 Uranus	8 Neptune
1 Mercury	--	16	10	10	10	8	8	8
2 Venus	10	--	18	10	10	8	8	8
3 Earth	8	18	--	18	10	8	8	8
4 Mars	8	12	24	--	12	10	10	10
5 Jupiter	8	8	8	8	--	16	12	8
6 Saturn	8	8	8	8	16	--	16	12
7 Uranus	8	8	8	8	10	12	--	16
8 Neptune	8	8	8	8	10	10	18	--

For the harmonic representations of secular perturbations, a 25-point analysis was considered for all the planets. This was found to be sufficient. The computations were carried out with SAO's CDC 6400. The following table gives the execution time required for the computations.

Table 3. Running time

n	Running time (sec)
8	60
10	124
12	232
16	658
18	1091
24	3032

The author, who is mainly responsible for the program, feels that a great deal of improvement can be done on the program to decrease the required storage. The execution time will not be reduced very much.

The results of the first-order perturbations of the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune are given in the Appendix. The results are reproduced directly from the computer output. The perturbations in Hansen variables, in longitude and log (radius vector), have been given as well as those of rectangular coordinates. As described in Section 4.3, they have been obtained from the perturbations of rectangular coordinates. They are given to aid anyone who might wish to compare our results with those of Newcomb and Clemence.

6. ACKNOWLEDGMENTS

The author would like to acknowledge the great interest and the continuous enthusiasm that Prof. Whipple and Dr. Lundquist have shown in this work.

Several consultations were held with Prof. Clemence during various stages of the work. It is primarily due to his pioneer work on Mars that I have been able to carry out this work. I would like to acknowledge the encouragement and invaluable advice that Prof. Clemence gave and is still giving.

I also wish to acknowledge fruitful discussions during the early stages of the work held with Dr. Payne and Dr. Morrison of NASA Electronics Research Center in Cambridge.

I am also very grateful for the help and interest of Mr. McNulty, who is entirely responsible for producing the computer output of the final results reproduced in this work. Mr. McNulty also assisted me during the later stage of the programming work.

REFERENCES

BROUWER, D.

1944. Integration of the equations of general planetary theory in rectangular coordinates. *Astron. Journ.*, vol. 51, pp. 37-43.

BROUWER, D. and CLEMENCE, G. M.

1961. *Methods of Celestial Mechanics*. Academic Press, New York, 598 pp. (2nd printing, 1965).

CLEMENCE, G. M.

1949. First-order theory of Mars. *Astron. Papers Amer. Ephem. Naut. Almanac*, vol. 11, part 2, pp. 225-500.
1961. Theory of Mars — completion. *Astron. Papers Amer. Ephem. Naut. Almanac*, vol. 16, part 2, pp. 261-333.

DAVIS, M. S.

1952. A study of the method of rectangular coordinates in general planetary theory. *Astron. Journ.*, vol. 56, pp. 188-199.

HILL, G. W.

1890. A new theory of Jupiter and Saturn. *Astron. Papers Amer. Ephem. Naut. Almanac*, vol. 4, pp. 1-577.

LEVERRIER, U. J. J.

1876. Théorie mouvement de Jupiter. *Ann. de l'Obs. de Paris*, vol. 11, pp. 105-272.

NEWCOMB, S.

1895. Tables of the heliocentric motion of Venus. *Astron. Papers Amer. Ephem. Naut. Almanac*, vol. 6, pp. 271-382.

APPENDIX A
FIRST-ORDER THEORY
PERIODIC AND SECULAR TERMS

Table A-1. Mercury
Periodic Terms
a) Venus on Mercury

J	K	Dx		Dy		Dz		U/COS(1)	
		(IN UNITS OF 1000(-12))		(IN UNITS OF 1000(-12))		(IN UNITS OF 1000(-12))		(1000(-4) SECONDS OF ARC)	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	13298	0	-698	0	11002	0	59	0
0	1	-46755	1852	1109	-41087	0	0	0	0
0	2	16166	-847	677	16131	-2213	-1606	-12	-9
0	3	2697	-266	265	2661	-170	-170	-1	-1
0	4	373	-95	94	176	-30	-29	0	0
0	5	54	-26	26	54	-5	-5	0	0
0	6	6	-7	7	6	-1	-1	0	0
0	7	0	-2	2	0	0	0	0	0
1	-11	-1	2	2	1	0	0	0	0
1	-10	-6	8	8	6	0	0	0	0
1	-9	-21	30	30	21	0	0	0	0
1	-8	-81	115	114	81	0	0	0	0
1	-7	-311	438	437	310	0	-2	0	0
1	-6	-1108	1684	1677	1103	3	-10	0	0
1	-5	-4440	6518	6484	4415	13	-51	0	0
1	-4	-16092	25366	25105	17066	72	-276	0	-1
1	-3	-70107	98728	97740	69612	366	-1569	2	-8
1	-2	-263551	371305	364935	257582	2691	-18118	14	-97
1	-1	-108786	176433	177456	113766	26860	-27556	132	-167
1	0	486966	-672234	689377	487068	-30784	21091	-161	112
1	1	180478	-226936	221672	169088	-17615	7050	-96	62
1	2	32666	-50637	50253	32610	-1628	716	-9	4
1	3	7776	-12319	12249	7736	-285	136	-2	1
1	4	1019	-3063	3049	1011	-53	26	0	0
1	5	483	-775	773	482	-11	5	0	0
1	6	126	-199	198	123	-2	1	0	0
1	7	32	-52	51	32	0	0	0	0
1	8	8	-13	13	8	0	0	0	0
1	9	2	-4	4	2	0	0	0	0
2	-13	0	-2	-2	0	0	0	0	0
2	-12	-2	-7	-7	2	0	0	0	0
2	-11	-9	-27	-27	9	0	0	0	0
2	-10	-35	-103	-102	35	0	0	0	0
2	-9	-132	-387	-386	132	0	0	0	0
2	-8	-501	-1467	-1462	499	0	0	0	0
2	-7	-1605	-5577	-5554	1607	0	6	0	0
2	-6	-7768	-21255	-21148	7731	-2	18	0	0
2	-5	-27741	-81040	-80518	27570	-13	86	0	0
2	-4	-105074	-306351	-303502	104112	-97	476	-1	3
2	-3	-379726	-1102418	-1085921	373639	-1661	2260	-8	12
2	-2	-967840	-2756128	-2621290	922458	14319	38783	76	207
2	-1	565663	1681746	1827846	630002	-16889	47657	-89	276
2	0	130782	3808356	-1775780	1319769	15709	-66930	-86	-166
2	1	255135	708763	-704097	253756	1071	-8551	11	-66
2	2	56650	155678	-154875	56150	279	-1123	1	-6
2	3	13625	36826	-36671	13367	48	-201	0	-1
2	4	3305	9042	-9010	3293	9	-39	0	0
2	5	832	2272	-2265	829	2	-8	0	0
2	6	212	580	-578	212	0	-2	0	0
2	7	55	150	-149	55	0	0	0	0
2	8	14	39	-39	14	0	0	0	0
2	9	4	10	-10	4	0	0	0	0
2	10	0	3	-3	0	0	0	0	0
3	-13	-2	0	0	2	0	0	0	0
3	-12	-6	-2	-2	6	0	0	0	0
3	-11	-22	-6	-6	22	0	0	0	0
3	-10	-82	-23	-23	82	0	0	0	0
3	-9	-307	-86	-85	306	0	0	0	0
3	-8	-1151	-320	-319	1146	0	2	0	0
3	-7	-4310	-1196	-1191	4290	4	8	0	0
3	-6	-16062	-4442	-4421	15972	18	41	0	0
3	-5	-58953	-16246	-16156	58530	90	216	0	1
3	-4	-206243	-56465	-56136	206239	431	1101	2	6
3	-3	-594266	-161935	-159998	586607	10342	5310	55	28
3	-2	818821	168521	99580	-620113	57066	58511	304	312
3	-1	1872968	488321	483599	1894669	-23699	-24623	-126	-130
3	0	-289976	-34987	31436	-286019	-18577	-17287	-88	-92
3	1	-76661	-11695	11563	-75863	-1538	-1658	-8	-1
3	2	-18887	-3044	3017	-18551	-261	-273	-1	-1
3	3	-4698	-777	772	-4633	-68	-50	0	0
3	4	-1180	-200	199	-1175	-10	-10	0	0
3	5	-303	-52	52	-302	-2	-2	0	0
3	6	-78	-13	13	-78	0	0	0	0
3	7	-20	-4	4	-20	0	0	0	0
3	8	-5	0	0	-5	0	0	0	0
3	9	-1	0	0	-1	0	0	0	0
4	-12	2	-2	-2	2	0	0	0	0
4	-11	7	-7	-7	7	0	0	0	0
4	-10	27	-26	-26	27	0	0	0	0
4	-9	106	-101	-100	105	0	0	0	0
4	-8	422	-397	-394	418	-3	3	0	0
4	-7	1704	-1580	-1566	1681	-13	13	0	0
4	-6	6965	-6358	-6267	6806	-59	58	0	0
4	-5	28327	-25564	-24940	27605	-313	218	-2	1
4	-4	109037	-97838	-97381	102195	-1350	-856	-7	-5
4	-3	266311	-248305	-191183	191838	-15529	4060	-83	22
4	-2	709103	172306	164172	-197793	-16066	1739	-75	9
4	-1	-422892	400905	-399660	-620810	13892	-2217	74	-12
4	0	-66517	64407	-64066	-66251	2701	-522	14	-3
4	1	-13263	12851	-12709	-13208	292	-66	2	0
4	2	-3029	2958	-2948	-3019	53	-10	0	0
4	3	-729	713	-711	-727	10	-2	0	0
4	4	-181	177	-177	-180	2	0	0	0
4	5	-46	45	-45	-46	0	0	0	0
4	6	-12	11	-11	-12	0	0	0	0
4	7	-3	3	-3	-3	0	0	0	0
5	-14	0	3	3	0	0	0	0	0
5	-13	2	10	10	-2	0	0	0	0
5	-12	7	38	38	-7	0	0	0	0
5	-11	26	144	144	-26	0	0	0	0
5	-10	98	545	544	-97	0	0	0	0
5	-9	375	2072	2069	-373	2	0	0	0

Table A-1. (Cont.)

a) Venus on Mercury

5	-8	1469	7932	7920	-1441	9	-5	0	0
5	-7	5680	30612	30575	-5617	38	-32	0	0
5	-6	22307	119420	119327	-22163	137	-210	1	-1
5	-5	80947	472505	472300	-80837	339	-1659	2	-9
5	-4	363885	1885148	1882592	-360159	4613	-8131	24	-43
5	-3	1387014	6436151	6136769	-1347025	48907	-105206	261	-561
5	-2	-235218	-1798117	1812018	-240000	-8638	17207	-46	0
5	-1	-1488800	-6945955	6876300	-1473401	-14639	35795	-78	180
5	0	-295812	-1369093	1359502	-293691	-1538	3598	-8	19
5	1	-67083	-309758	308099	-66719	-231	532	-1	3
5	2	-16105	-74260	73919	-16034	-62	97	0	1
5	3	-3089	-18377	18311	-3078	-8	19	0	0
5	4	-1008	-6661	6626	-1005	-2	6	0	0
5	5	-258	-1188	1185	-257	0	0	0	0
5	6	-67	-307	307	-67	0	0	0	0
5	7	-17	-80	80	-17	0	0	0	0
5	8	-5	-21	21	-5	0	0	0	0
5	9	-1	-6	6	-1	0	0	0	0
5	10	0	-1	1	0	0	0	0	0
6	-17	3	2	2	-3	0	0	0	0
6	-11	11	6	6	-11	0	0	0	0
6	-10	37	19	21	-39	1	0	0	0
6	-9	126	61	71	-137	4	0	0	0
6	-8	431	196	242	-486	10	0	0	0
6	-7	1527	656	865	-1795	8	11	0	0
6	-6	5858	2539	3601	-7082	-145	51	-1	0
6	-5	26222	11025	13821	-27831	26	26	0	0
6	-4	76543	36354	18953	-47999	-2519	-3083	-13	-21
6	-3	-60324	-29823	15627	-22960	-3570	-6036	-19	-32
6	-2	-147356	-65945	65675	-147474	2273	3668	12	20
6	-1	-11257	-5614	5667	-11336	764	1120	4	6
6	0	-1352	-772	774	-1361	67	102	0	1
6	1	-259	-148	149	-260	13	19	0	0
6	2	-54	-32	32	-54	2	4	0	0
6	3	-12	-7	7	-12	0	0	0	0
6	4	-3	-2	2	-3	0	0	0	0
7	-12	-2	1	1	1	0	0	0	0
7	-11	-9	6	5	6	0	0	0	0
7	-10	-39	24	21	28	2	-1	0	0
7	-9	-168	98	85	120	5	-2	0	0
7	-8	-666	383	324	479	12	6	0	0
7	-7	-2415	1433	1207	1782	18	58	0	0
7	-6	-8086	5050	4749	6972	206	-100	1	-1
7	-5	-26993	18070	21577	35916	-397	53	-2	0
7	-4	-76172	50394	35366	66397	6304	379	34	2
7	-3	-64445	-36870	36202	62749	533	-40	3	0
7	-2	96839	-65133	66723	94216	-2362	-10	-12	0
7	-1	16253	-11336	11270	16168	-328	6	-2	0
7	0	3436	-2396	2385	3420	-40	0	0	0
7	1	802	-561	559	799	-7	0	0	0
7	2	195	-137	136	195	-1	0	0	0
7	3	49	-34	34	49	0	0	0	0
7	4	12	-9	9	12	0	0	0	0
7	5	3	-2	2	3	0	0	0	0
7	16	2	0	0	-2	0	0	0	0
8	-12	0	3	1	0	0	0	0	0
8	-11	-2	15	7	-1	0	-1	0	0
8	-10	-8	60	32	-2	0	-2	0	0
8	-9	-28	223	128	-3	6	-1	0	0
8	-8	-73	744	496	-3	21	6	0	0
8	-7	-147	2279	2162	-6	-4	-81	0	0
8	-6	-175	7172	10399	-1030	-55	161	0	0
8	-5	-2361	26062	19539	593	1007	-1329	5	-7
8	-4	-2390	-71308	-56586	4561	3486	-4462	19	-25
8	-3	2608	-89140	89190	2317	-1283	1695	-7	9
8	-2	3201	39759	-39112	3179	-660	1032	-4	6
8	-1	676	9385	-9300	671	-64	96	0	1
8	0	193	7234	-2220	152	-11	16	0	0
8	1	37	551	-568	37	-2	3	0	0
8	2	9	139	-138	9	0	0	0	0
8	3	2	35	-35	2	0	0	0	0
8	4	0	9	-9	0	0	0	0	0
8	5	0	2	-2	0	0	0	0	0
8	16	0	1	1	0	0	0	0	0
9	-15	0	2	-2	1	0	0	0	0
9	-13	0	0	-1	0	0	0	0	0
9	-12	0	1	-3	0	0	0	0	0
9	-11	0	4	0	0	0	0	0	0
9	-10	-3	9	-29	30	2	-2	0	0
9	-9	-45	-14	-87	97	6	-3	0	0
9	-8	-307	-219	-179	243	-25	-1	0	0
9	-7	-1266	-1040	-113	518	56	96	0	0
9	-6	-2719	-1494	-6188	4307	-79	-220	0	-1
9	-5	-11344	-7977	-2593	5257	360	1082	2	6
9	-4	8939	6820	-4783	7264	188	461	1	2
9	-3	16266	10550	-10500	16218	-196	-691	-1	-3
9	-2	2232	1435	-1433	2227	-66	-98	0	-1
9	-1	607	266	-265	606	-4	-10	0	0
9	0	92	59	-59	91	0	-2	0	0
9	1	22	14	-14	22	0	0	0	0
9	2	5	3	-3	5	0	0	0	0
9	3	1	0	0	1	0	0	0	0
9	16	-3	-6	-6	3	0	0	0	0
10	-16	4	0	0	5	0	0	0	0
10	-14	1	0	0	0	0	0	0	0
10	-13	3	0	0	0	0	0	0	0
10	-12	11	-3	-3	0	0	0	0	0
10	-11	36	-10	-11	-14	0	-1	0	0
10	-10	105	-40	-41	-78	0	-2	0	0
10	-9	321	-151	-164	-390	-7	9	0	0
10	-8	1250	-615	-621	-1630	31	-4	0	0
10	-7	6088	-2483	-2267	-4537	-145	-36	-1	0
10	-6	19007	-9168	-9671	-22554	0	0	0	0
10	-5	59834	-28873	-26263	-52009	-2739	-714	-15	-4
10	-4	-30342	11509	-11488	-29996	437	162	2	1
10	-3	-67204	32647	-32346	-66597	687	118	4	1
10	-2	-12799	6258	-6215	-12715	77	12	0	0
10	-1	-2857	1398	-1391	-2842	11	2	0	0
10	0	-681	334	-332	-678	2	0	0	0
10	1	-168	82	-82	-167	0	0	0	0
10	2	-42	21	-21	-42	0	0	0	0
10	3	-11	5	-5	-11	0	0	0	0
10	4	-3	1	-1	-3	0	0	0	0
10	15	-1	0	0	-1	0	0	0	0
10	16	1	0	0	-1	0	0	0	0

Table A-1. (Cont.)

a) Venus on Mercury

11	-16	3	-3	2	2	0	0	0	0
11	-15	4	-5	5	4	0	0	0	0
11	-14	1	-2	2	1	0	0	0	0
11	-13	2	-3	2	1	0	0	0	0
11	-12	3	-5	2	2	0	0	0	0
11	-11	2	-6	2	2	0	0	0	0
11	-10	-8	3	-16	-13	0	0	0	0
11	-9	-16	-29	-121	-54	5	-13	0	0
11	-8	181	-480	56	114	-34	34	0	0
11	-7	-37	-441	-1594	-485	65	-53	0	0
11	-6	771	-3288	-1276	-61	-204	175	-1	1
11	-5	-627	2019	-610	-349	-218	209	-1	1
11	-4	-1078	5861	-5853	-1064	124	-119	1	-1
11	-3	-72	135	-144	-73	37	-42	0	0
11	-2	-8	-74	23	-9	4	-4	0	0
11	-1	-1	-8	8	-1	0	0	0	0
11	0	0	-3	3	0	0	0	0	0
11	15	-2	2	2	2	0	0	0	0
11	16	-9	12	12	9	0	0	0	0
12	-16	-3	-13	13	-4	0	0	0	0
12	-15	0	-2	2	0	0	0	0	0
12	-14	0	-1	1	0	0	0	0	0
12	-13	0	-2	2	0	0	0	0	0
12	-12	2	2	0	0	0	0	0	0
12	-11	8	14	-7	1	2	0	0	0
12	-10	14	23	-4	-10	-4	-4	0	0
12	-9	6	-51	170	-107	4	18	0	0
12	-8	116	405	-89	-34	-5	-43	0	0
12	-7	535	397	1122	-1022	4	56	0	0
12	-6	2018	1918	785	-1002	-34	-250	0	-1
12	-5	-1606	-1700	1604	-1505	-8	-15	0	0
12	-4	-3615	-2233	2220	-2501	17	75	0	0
12	-3	-414	-363	361	-412	3	11	0	0
12	-2	-85	-75	74	-84	0	1	0	0
12	-1	-20	-17	17	-20	0	0	0	0
12	0	-5	-4	4	-5	0	0	0	0
12	1	-1	-1	1	-1	0	0	0	0
12	14	0	1	1	0	0	0	0	0
12	15	0	4	4	0	0	0	0	0
12	16	0	2	2	1	0	0	0	0
13	-16	-8	-4	4	-8	0	0	0	0
13	-15	-6	-1	1	-4	0	0	0	0
13	-14	-2	0	0	-2	0	0	0	0
13	-13	1	0	0	0	0	0	0	0
13	-12	7	0	-1	4	0	0	0	0
13	-11	6	0	-3	-5	-2	0	0	0
13	-10	-19	-13	7	-73	2	0	0	0
13	-9	107	2	-28	55	-17	-9	0	0
13	-8	99	-45	-29	-506	20	12	0	0
13	-7	834	-41	-11	-246	-82	-41	0	0
13	-6	-5366	1606	1549	4760	-307	-137	-2	-1
13	-5	-4315	924	-929	-4291	101	46	1	0
13	-4	3886	-1266	1250	5829	63	21	0	0
13	-3	865	-278	276	857	4	2	0	0
13	-2	203	-65	65	202	0	0	0	0
13	-1	50	-16	16	49	0	0	0	0
13	0	12	-4	4	12	0	0	0	0
13	1	3	-1	1	3	0	0	0	0
13	14	1	0	0	-1	0	0	0	0
13	15	3	1	1	-3	0	0	0	0
13	16	7	1	1	-7	0	0	0	0
14	-16	-7	5	-5	-6	0	0	0	0
14	-15	-2	1	0	-2	0	0	0	0
14	-14	2	-1	2	0	0	0	0	0
14	-13	-1	2	-1	0	0	0	0	0
14	-12	-13	13	-10	-13	2	-2	0	0
14	-11	33	-29	53	45	-7	4	0	0
14	-10	-70	106	-48	-53	13	-6	0	0
14	-9	-13	42	258	-16	13	8	0	0
14	-8	-184	451	142	15	41	-24	0	0
14	-7	156	-361	264	127	15	-11	0	0
14	-6	212	-616	614	211	-15	11	0	0
14	-5	26	-74	74	26	-3	3	0	0
14	-4	5	-12	12	5	0	0	0	0
14	-3	0	-3	3	0	0	0	0	0
14	-2	0	-2	2	-3	0	0	0	0
14	-1	3	-1	-1	-3	0	0	0	0
14	16	3	-1	-1	-3	0	0	0	0
15	-15	0	-4	4	0	0	0	0	0
15	-14	0	-2	2	0	0	0	0	0
15	-13	0	0	-2	0	0	0	0	0
15	-12	-1	4	-8	1	0	-1	0	0
15	-11	-9	-29	20	0	0	4	0	0
15	-10	-6	20	-72	31	-7	0	0	0
15	-9	-89	-146	-23	44	-1	10	0	0
15	-8	-240	-284	-419	300	1	-7	0	0
15	-7	-736	-897	-669	598	-2	75	0	0
15	-6	421	610	-598	413	1	-10	0	0
15	-5	893	1018	-1010	846	-1	-17	0	0
15	-4	158	187	-186	157	0	-2	0	0
15	-3	35	41	-41	35	0	0	0	0
15	-2	8	10	-10	8	0	0	0	0
15	-1	2	2	-2	2	0	0	0	0
15	15	0	1	1	0	0	0	0	0
15	16	1	10	10	-1	0	0	0	0
16	-16	-9	-5	5	-8	0	0	0	0
16	-15	-2	-1	1	-1	0	0	0	0
16	-14	0	0	0	1	0	0	0	0
16	-13	1	-1	2	0	0	0	0	0
16	-12	-9	-4	5	-9	1	0	0	0
16	-11	18	8	-8	24	-2	-2	0	0
16	-10	-38	-8	10	-26	-4	3	0	0
16	-9	1	9	-7	74	-6	-6	0	0
16	-8	-126	0	10	35	9	7	0	0
16	-7	122	-6	-11	3	11	7	0	0
16	-6	224	-14	14	223	-4	-4	0	0
16	-5	-8	3	-3	-8	-2	-1	0	0
16	-4	-4	1	0	-4	0	0	0	0
16	-3	0	0	0	-1	0	0	0	0
16	14	1	0	0	0	0	0	0	0
16	15	3	2	2	-3	0	0	0	0
16	16	0	2	1	0	0	0	0	0

Table A-1. (Cont.)

a) Venus on Mercury

I	K	NDP (IN UNITS OF 1000(-4))				MU SECONDS OF ARC				D (LONG.) (IN UNITS OF 1000(-9))			
		COS	SIN	COS	SIN	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-217	0	0	0	-66	0				
0	1	-2	4	222	-8	0	0	66	-2				
0	2	8	-17	28	6	8	-17	6	1				
0	3	0	-3	5	1	2	-6	1	0				
0	4	0	0	1	0	1	-2	0	0				
0	5	0	0	0	0	0	-1	0	0				
1	-8	0	0	0	0	1	0	0	0				
1	-7	0	0	0	0	2	1	0	0				
1	-6	0	0	0	0	8	6	1	-1				
1	-5	1	0	1	-1	29	20	3	-6				
1	-4	3	2	4	-6	106	75	11	-15				
1	-3	28	18	23	-36	397	282	37	-52				
1	-2	321	263	189	-252	1511	1086	128	-177				
1	-1	5673	3917	1297	-1809	5703	4120	286	-600				
1	0	1211	738	-57	121	2368	1557	-97	162				
1	1	97	25	-22	72	636	386	-66	77				
1	2	7	3	-3	8	166	101	-14	22				
1	3	1	0	-1	1	66	27	-6	6				
1	4	0	0	0	0	12	7	-1	2				
1	5	0	0	0	0	3	2	0	0				
1	6	0	0	0	0	1	1	0	0				
2	-10	0	0	0	0	-1	0	0	0				
2	-9	0	0	0	0	-2	1	0	0				
2	-8	0	0	0	0	-8	3	0	1				
2	-7	0	0	0	1	-28	9	1	4				
2	-6	-2	1	2	-102	35	5	5	-15				
2	-5	-13	4	9	27	-376	128	19	-55				
2	-4	-96	30	47	166	-1396	475	66	-196				
2	-3	-863	285	300	889	-5220	1782	230	-676				
2	-2	-13073	6392	2509	7468	-19888	6781	765	-2262				
2	-1	-32686	11398	1880	5622	-35100	12303	300	-867				
2	0	695	-63	52	296	-6835	2521	-261	-717				
2	1	27	0	-1	22	-1766	666	-89	-221				
2	2	2	0	0	3	-643	171	-25	-66				
2	3	0	0	0	0	-124	66	-27	-18				
2	4	0	0	0	0	-36	12	-2	-5				
2	5	0	0	0	0	-9	3	-1	-1				
2	6	0	0	0	0	-3	1	0	0				
2	7	0	0	0	0	-1	0	0	0				
3	-9	0	0	0	0	0	2	0	0				
3	-8	0	0	0	0	-2	6	1	0				
3	-7	0	1	2	1	-7	23	4	1				
3	-6	-1	4	8	3	-26	85	13	6				
3	-5	-8	25	41	12	-87	312	65	13				
3	-4	-52	180	219	63	-318	1165	157	66				
3	-3	-681	1647	1313	379	-1168	4156	521	165				
3	-2	-1627	14182	6326	1626	-3393	12833	1118	297				
3	-1	1622	-8247	1519	328	888	-5293	3	-13				
3	0	66	-165	79	35	201	-1092	97	17				
3	1	3	-7	8	3	69	-269	31	6				
3	2	0	-1	1	1	13	-20	9	2				
3	3	0	0	0	0	3	-19	3	0				
3	4	0	0	0	0	1	-5	1	0				
3	5	0	0	0	0	0	-1	0	0				
4	-8	0	0	0	0	-1	-1	0	0				
4	-7	1	1	1	-1	-6	-5	-1	1				
4	-6	3	4	5	-3	-22	-22	-3	3				
4	-5	14	20	17	-11	-88	-91	-11	11				
4	-4	38	65	19	-2	-388	-617	-51	68				
4	-3	-1319	-1573	-963	811	-1937	-2208	-271	237				
4	-2	-3118	-3233	-982	926	-3361	-3502	-169	163				
4	-1	211	238	-118	110	-697	-502	56	-52				
4	0	11	16	-9	6	-126	-126	17	-17				
4	1	1	1	-1	1	-36	-36	5	-5				
4	2	0	0	0	0	-9	-9	-1	-1				
4	3	0	0	0	0	-2	-3	0	0				
4	4	0	0	0	0	-1	-1	0	0				
5	-11	0	0	0	0	1	0	0	0				
5	-10	0	0	0	0	3	0	0	0				
5	-9	0	0	0	0	10	-2	0	-2				
5	-8	1	0	0	-2	38	-6	-1	-6				
5	-7	4	0	0	-7	138	-26	-6	-21				
5	-6	21	-1	-3	-30	502	-88	-13	-73				
5	-5	96	-8	-13	-121	1829	-327	-65	-250				
5	-4	376	-76	-82	-688	6765	-1238	-156	-836				
5	-3	13686	-1837	-962	-6888	27883	-6944	-519	-2911				
5	-2	68123	-15130	-530	-2720	71811	-15699	-71	-273				
5	-1	-661	49	-26	-222	16600	-3161	329	1515				
5	0	-22	2	-2	-21	3671	-800	100	661				
5	1	-2	0	0	-3	972	-212	29	133				
5	2	0	0	0	-1	261	-57	8	38				
5	3	0	0	0	0	21	-15	2	11				
5	4	0	0	0	0	19	-6	1	3				
5	5	0	0	0	0	5	-1	0	1				
5	6	0	0	0	0	1	0	0	0				
6	-9	0	0	0	0	1	-1	0	0				
6	-8	1	-1	-2	-1	2	-6	-1	0				
6	-7	3	-6	-4	-3	6	-12	-2	-1				
6	-6	4	-6	-5	-6	14	-29	-6	-2				
6	-5	-35	51	28	21	30	-79	-8	-3				
6	-4	193	-366	-238	-126	279	-566	-73	-36				
6	-3	682	-1099	-637	-195	698	-1120	-79	-35				
6	-2	-101	269	-86	-35	6	8	8	6				
6	-1	-6	12	-6	-3	1	1	1	1				
6	0	0	1	-1	0	1	-1	0	0				
7	-9	0	-1	-1	0	0	0	0	0				
7	-8	0	-2	-1	0	1	1	0	0				
7	-7	0	0	1	-1	7	11	2	-1				

Table A-1. (Cont.)
a) Venus on Mercury

7	-6	9	23	19	-8	26	47	7	-4
7	-5	-23	-54	-27	10	64	88	9	-7
7	-4	280	485	269	-156	383	627	73	-45
7	-3	531	751	159	-107	582	841	23	-16
7	-2	-23	-37	18	-12	100	141	-15	11
7	-1	-1	-2	2	-1	25	36	-5	3
7	0	0	0	0	0	7	10	-1	1
7	1	0	0	0	0	2	3	0	0
7	2	0	0	0	0	0	1	0	0
R	-9	-1	0	0	0	1	0	0	0
R	-8	1	0	0	-1	4	0	0	-1
R	-7	8	2	2	-6	16	2	0	-2
R	-6	-22	-5	-3	12	27	-1	0	-3
R	-5	110	10	6	-79	205	14	2	-27
R	-4	660	15	8	-309	560	24	2	-48
R	-3	-688	33	-2	-90	-551	36	-1	-6
R	-2	-15	0	0	-7	-120	7	-1	-12
R	-1	-1	0	0	-1	-30	2	0	-4
R	0	0	0	0	0	-8	0	0	-1
R	1	0	0	0	0	-2	0	0	0
R	2	0	0	0	0	-1	0	0	0
9	-8	2	-1	-1	-1	0	1	0	0
9	-7	-7	7	5	5	-8	9	1	1
9	-6	14	-14	-8	-8	-2	7	0	0
9	-5	-51	65	39	29	-63	87	11	8
9	-4	-77	122	40	26	-85	132	7	4
9	-3	9	-15	7	4	-9	14	-2	-1
9	-2	1	-1	0	0	-2	3	-1	0
9	-1	0	0	0	0	-1	1	0	0
10	-10	0	0	0	0	0	-1	0	0
10	-9	0	-1	-1	0	-1	-2	0	0
10	-8	0	4	3	0	-2	-4	0	0
10	-7	-2	-9	-7	2	-11	-28	-4	2
10	-6	0	6	-1	1	-34	-74	-9	4
10	-5	-87	-227	-117	45	-150	-353	-38	16
10	-4	-310	-623	-48	22	-326	-667	-5	3
10	-3	4	10	-5	2	-64	-129	14	-7
10	-2	0	1	0	0	-16	-33	4	-2
10	-1	0	0	0	0	-4	-9	1	-1
10	0	0	0	0	0	-1	-2	0	0
10	1	0	0	0	0	0	-1	0	0
11	-9	1	1	1	-1	0	0	0	0
11	-8	-3	-2	-1	2	-3	-1	0	1
11	-7	5	2	1	-3	-1	1	0	0
11	-6	-16	-4	-3	10	-23	-5	-1	3
11	-5	-43	-7	-3	18	-43	-8	-1	3
11	-4	14	2	-1	4	4	0	0	0
11	-3	1	0	0	0	1	0	0	0
12	-10	1	0	0	0	0	0	0	0
12	-9	-1	1	1	1	-1	0	0	0
12	-8	2	-1	-1	-2	2	-2	0	0
12	-7	-3	2	1	2	1	-2	0	0
12	-6	13	-12	-7	-7	16	-16	-2	-2
12	-5	17	-20	-5	-4	19	-22	-1	-1
12	-4	-1	1	-1	-1	3	-3	0	0
12	-3	0	0	0	0	1	-1	0	0
13	-10	0	1	0	0	0	0	0	0
13	-9	0	-1	-1	0	0	-1	0	0
13	-8	0	2	1	0	0	-1	0	0
13	-7	-1	-5	-3	1	-1	-8	-1	0
13	-6	-7	-32	-15	3	-4	-21	-2	0
13	-5	17	55	-5	1	15	48	0	0
13	-4	0	1	0	0	3	10	-1	0
13	-3	0	0	0	0	1	3	0	0
13	-2	0	0	0	0	0	1	0	0
14	-9	1	0	0	0	1	0	0	0
14	-8	-1	-1	0	0	0	0	0	0
14	-7	3	1	1	-2	3	1	0	0
14	-6	5	1	1	-2	5	2	0	0
14	-5	-1	0	0	0	0	0	0	0
15	-9	0	0	0	0	-1	0	0	0
15	-8	0	0	0	0	-1	1	0	0
15	-7	-5	3	2	2	-6	5	1	1
15	-6	-9	8	1	1	-10	8	0	0
15	-5	0	0	0	0	-2	2	0	0
16	-8	0	1	0	0	0	1	0	0
16	-7	0	2	1	0	0	2	0	0
16	-6	0	-1	0	0	0	0	0	0

Table A-1. (Cont.)
 Secular Terms
 a) Venus on Mercury

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-2137717	0	-43991923	0	-2172068	0
1	-218473	1529272	1529266	-369269	6931567	-12167341
2	653119	14358423	-14045089	637779	703779	-1239834
3	202688	4357602	-4309588	200349	107280	-189337
4	55284	1179800	-1171093	54861	19389	-34256
5	14684	312223	-310490	14601	3850	-6808
6	3878	82271	-81905	3860	812	-1436
7	1024	21696	-21616	1020	178	-316
8	271	5735	-5717	270	40	-72
9	72	1520	-1516	72	9	-17
10	19	404	-404	19	2	-4
11	5	106	-109	5	0	0
12	2	21	-36	0	0	0

ND7 NU U/COS(T)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	9218	0	-114	0	-1620	0
1	-44478	2185	-1093	-22239	5171	-9077
2	-2266	111	-111	-2266	525	-925
3	-231	11	-17	-346	80	-141
4	-31	2	-3	-63	14	-26
5	-5	0	-1	-12	3	-5
6	-1	0	0	-3	1	-1
7	0	0	0	-1	0	0

Table A-1. (Cont.)
Periodic Terms
b) Earth on Mercury

		DX		DY		DZ		U/COS(11)	
		(IN UNITS OF 10**(-12))							
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	11295	0	-252	0	2736	0	15	0
0	1	-16841	941	492	-14971	0	0	0	0
0	2	5059	-300	270	5064	-426	-759	-2	-4
0	3	838	-148	146	840	-61	-96	0	-1
0	4	137	-52	51	137	-7	-16	0	0
0	5	22	-15	15	22	-1	-3	0	0
0	6	3	-4	4	3	0	0	0	0
0	7	0	-1	1	0	0	0	0	0
1	-10	-3	1	1	3	0	0	0	0
1	-9	-10	5	5	10	0	0	0	0
1	-8	-38	19	19	38	0	0	0	0
1	-7	-145	71	71	144	0	0	0	0
1	-6	-554	273	272	551	1	-2	0	0
1	-5	-2130	1048	1042	2119	7	-12	0	0
1	-4	-8224	4033	4006	8165	34	-65	0	0
1	-3	-31508	15436	15290	31172	185	-411	1	-2
1	-2	-113512	55820	55061	111021	1422	-4140	8	-22
1	-1	-55955	34750	31194	49647	10790	-1639	57	-9
1	0	240885	-111653	122598	245595	-8900	-2362	-47	-13
1	1	77387	-42982	42027	76488	-8083	-4458	-43	-24
1	2	16640	-10319	10227	16518	-789	-459	-4	-2
1	3	3937	-2552	2536	3915	-129	-73	-1	0
1	4	966	-639	636	962	-24	-14	0	0
1	5	243	-162	162	242	-5	-3	0	0
1	6	62	-42	42	62	-1	0	0	0
1	7	16	-11	11	16	0	0	0	0
1	8	4	-3	3	4	0	0	0	0
1	9	0	0	0	1	0	0	0	0
2	-10	8	-10	-11	-9	0	0	0	0
2	-9	32	-39	-40	-32	0	0	0	0
2	-8	121	-148	-148	-120	0	0	0	0
2	-7	453	-557	-555	-451	-1	-2	0	0
2	-6	1695	-2087	-2076	-1686	-5	-12	0	0
2	-5	6297	-7770	-7717	-6257	-25	-12	0	0
2	-4	22892	-28303	-28035	-22490	-136	-72	-1	0
2	-3	77152	-95768	-94283	-76094	-815	-502	-4	-3
2	-2	176155	-221772	-213195	-149181	-4124	-1155	-22	6
2	-1	-136335	157513	-189613	-149572	-25469	-4229	-136	-23
2	0	-345200	430547	-428922	-343037	16227	2290	86	12
2	1	-57622	76762	-76270	57343	2783	248	15	6
2	2	-11773	15958	-15879	-11721	340	39	2	0
2	3	-2697	3696	-3681	-2686	57	6	0	0
2	4	-650	897	-894	-648	11	1	0	0
2	5	-161	224	-223	-161	2	0	0	0
2	6	-41	57	-57	-41	0	0	0	0
2	7	-10	15	-15	-11	0	0	0	0
2	8	-3	4	-4	-3	0	0	0	0
2	9	0	0	-2	-1	0	0	0	0
2	10	3	-3	-4	-3	0	0	0	0
3	-10	0	4	3	0	0	0	0	0
3	-9	0	14	13	0	0	0	0	0
3	-8	0	54	53	0	0	0	0	0
3	-7	-2	217	216	2	0	-1	0	0
3	-6	-26	888	881	24	4	-6	0	0
3	-5	-183	3701	3655	169	18	-27	0	0
3	-4	-1118	15616	15249	1017	125	-130	1	-1
3	-3	-5708	63195	59839	5010	1515	-186	8	-1
3	-2	-3794	122090	62278	-10200	12644	-4339	67	-23
3	-1	24169	-148326	153902	21962	1125	-931	6	-5
3	0	-1223	-151798	150716	-1186	-4068	2037	-22	11
3	1	-771	-27399	27232	-755	-467	262	-2	1
3	2	-194	-5928	5899	-192	-64	35	0	0
3	3	-50	-1393	1387	-49	-11	6	0	0
3	4	-13	-341	339	-13	-2	1	0	0
3	5	-3	-85	85	-3	0	0	0	0
3	6	0	-22	22	0	0	0	0	0
3	7	0	-6	6	0	0	0	0	0
3	8	0	-2	2	0	0	0	0	0
3	10	0	-2	-1	0	0	0	0	0
4	-10	-9	-15	-20	9	0	0	0	0
4	-9	-34	-64	-69	34	0	0	0	0
4	-8	-130	-249	-250	129	0	0	0	0
4	-7	-496	-940	-941	494	-4	2	0	0
4	-6	-1909	-3354	-3361	1902	-16	10	0	0
4	-5	-7406	-13495	-13564	7379	-64	52	0	0
4	-4	-28979	-51460	-52285	28950	-180	336	-1	2
4	-3	-113981	-198323	-204355	113957	-1595	1933	-8	10
4	-2	-349217	-536353	-484349	328145	-22330	26331	-119	140
4	-1	133538	298362	-300465	137523	5578	-6008	30	-32
4	0	376267	580306	-574585	372402	2839	-4775	15	-25
4	1	74871	114494	-113701	74340	292	-496	2	-3
4	2	16995	25919	-25781	16904	45	-75	0	0
4	3	4081	6215	-6188	4063	8	-14	0	0
4	4	1011	1538	-1533	1007	2	-3	0	0
4	5	255	388	-387	255	0	0	0	0
4	6	65	99	-99	65	0	0	0	0
4	7	17	26	-26	17	0	0	0	0
4	8	4	6	-7	5	0	0	0	0
4	9	0	-1	-5	2	0	0	0	0
4	10	-3	-11	-12	3	0	0	0	0
5	-10	2	4	-6	4	0	0	0	0
5	-9	-1	0	-9	7	0	0	0	0
5	-8	-12	-10	-15	15	0	0	0	0
5	-7	-38	-27	-40	45	-2	0	0	0
5	-6	-112	-55	-117	151	-1	-4	0	0
5	-5	-371	-126	-437	590	34	-24	0	0
5	-4	-1672	-807	-2234	2638	26	-77	0	0
5	-3	-6992	-5259	-11493	3193	783	-185	-1	4
5	-2	5168	3769	-2124	1521	-164	1452	-1	8
5	-1	14046	8872	-8835	14100	71	-632	0	-3
5	0	696	662	-668	706	-7	-174	0	-1
5	1	68	91	-92	69	0	-18	0	0

Table A-1. (Cont.)

b) Earth on Mercury

5	2	11	18	-18	11	0	-3	0	0
5	3	2	4	-4	2	0	0	0	0
5	9	-2	-3	-3	2	0	0	0	0
5	10	-7	-12	-12	7	0	0	0	0
6	-10	11	8	-8	10	0	0	0	0
6	-9	8	5	-7	9	0	0	0	0
6	-8	7	3	-5	3	0	0	0	0
6	-7	28	10	-7	0	0	-2	0	0
6	-6	107	39	-24	3	5	-13	0	0
6	-5	257	78	-110	42	-7	-23	0	0
6	-4	91	-214	299	-1289	14	94	0	1
6	-3	2155	219	-327	-81	-93	-290	0	-2
6	-2	-1796	-239	223	-1756	-59	-95	0	-1
6	-1	-2431	64	-67	-2423	46	87	0	0
6	0	-371	19	-18	-370	9	13	0	0
6	1	-72	4	-4	-72	0	2	0	0
6	2	-16	0	0	-16	0	0	0	0
6	3	-4	0	0	-4	0	0	0	0
6	8	-2	-1	-1	2	0	0	0	0
6	9	-6	-4	-4	6	0	0	0	0
6	10	-21	-14	-14	21	0	0	0	0
7	-10	25	4	-4	24	0	0	0	0
7	-9	13	2	-2	14	0	0	0	0
7	-8	10	2	0	10	0	0	0	0
7	-7	18	5	0	23	0	-4	0	0
7	-6	7	17	4	58	-3	-2	0	0
7	-5	-214	38	29	-132	16	21	0	0
7	-4	8	103	195	539	-27	-33	0	0
7	-3	-660	358	129	-18	102	83	1	0
7	-2	718	-352	362	719	0	-6	0	0
7	-1	574	-408	406	571	-21	-11	0	0
7	0	98	-73	72	98	-3	-1	0	0
7	1	21	-15	15	21	0	0	0	0
7	2	5	-4	4	5	0	0	0	0
7	3	1	0	0	1	0	0	0	0
7	7	-1	0	0	1	0	0	0	0
7	8	-3	0	0	3	0	0	0	0
7	9	-11	-2	-2	11	0	0	0	0
7	10	-28	-4	-4	27	0	0	0	0
8	-10	30	-9	8	28	0	0	0	0
8	-9	16	-6	4	15	0	0	0	0
8	-8	10	-5	0	8	0	-1	0	0
8	-7	8	-7	-6	4	0	0	0	0
8	-6	-25	-10	-50	-59	6	3	0	0
8	-5	115	-151	-55	24	-14	-5	0	0
8	-4	176	-353	-475	-261	7	4	0	0
8	-3	366	-962	-742	-206	-122	-11	-1	0
8	-2	-426	748	-758	-427	27	4	0	0
8	-1	-380	1051	-1041	-376	16	-2	0	0
8	0	-72	203	-202	-72	2	0	0	0
8	1	-16	46	-45	-16	0	0	0	0
8	2	-4	11	-11	-4	0	0	0	0
8	3	0	3	-3	0	0	0	0	0
8	7	-1	0	0	1	0	0	0	0
8	8	-4	1	1	4	0	0	0	0
8	9	-13	4	4	13	0	0	0	0
8	10	-29	9	9	29	0	0	0	0
9	-10	24	-22	20	22	0	0	0	0
9	-9	6	-4	4	6	0	0	0	0
9	-8	0	0	0	2	0	0	0	0
9	-7	-8	8	-11	-8	2	0	0	0
9	-6	13	-24	21	15	-4	0	0	0
9	-5	-12	12	-43	-11	5	0	0	0
9	-4	5	-63	-6	9	-7	3	0	0
9	-3	2	46	-7	-8	-9	5	0	0
9	-2	7	104	-103	7	4	-2	0	0
9	-1	-2	-2	2	-2	0	0	0	0
9	0	0	-1	1	0	0	0	0	0
9	7	-1	0	1	0	0	0	0	0
9	8	-3	2	3	3	0	0	0	0
9	9	-8	7	8	9	0	0	0	0
9	10	-7	2	2	6	0	0	0	0
10	-10	5	-4	6	5	0	0	0	0
10	-9	0	5	-3	0	0	0	0	0
10	-8	-1	5	-3	-1	0	0	0	0
10	-7	0	-7	10	0	-1	0	0	0
10	-6	0	11	-9	0	1	0	0	0
10	-5	0	-6	14	-4	-1	1	0	0
10	-4	6	11	-2	0	1	-2	0	0
10	-3	-5	-10	9	-4	0	0	0	0
10	-2	-8	-9	9	-8	0	0	0	0
10	-1	-1	1	1	-1	0	0	0	0
10	8	0	1	2	0	0	0	0	0
10	9	-1	0	0	2	0	0	0	0
10	10	3	-13	-12	-3	0	0	0	0

Table A-1. (Cont.)

b) Earth on Mercury

		NDZ		NU		D (LONG.)		D LOG(W)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))			
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-79	0	0	0	-17	0
0	1	-1	1	72	-3	0	0	15	-1
0	2	5	-4	9	3	4	-4	2	1
0	3	0	-1	2	0	1	-2	0	0
1	-7	0	0	0	0	0	1	0	0
1	-6	0	0	0	0	1	3	0	0
1	-5	0	0	0	0	5	10	1	-1
1	-4	1	1	0	-1	18	36	5	-3
1	-3	5	9	13	-7	66	134	18	-9
1	-2	50	108	92	-43	248	512	61	-30
1	-1	900	1872	750	-360	961	1968	163	-80
1	0	233	352	18	2	429	745	-36	19
1	1	41	20	-14	25	137	191	-23	16
1	2	2	1	-2	3	35	50	-7	5
1	3	0	0	0	0	9	13	-2	1
1	4	0	0	0	0	3	4	-1	0
1	5	0	0	0	0	1	1	0	0
2	-8	0	0	0	0	-1	-1	0	0
2	-7	0	0	0	0	-3	-2	0	0
2	-6	0	0	-1	1	-11	-9	-1	2
2	-5	-2	-2	-3	4	-41	-33	-5	6
2	-4	-13	-11	-18	21	-150	-122	-18	21
2	-3	-111	-91	-102	124	-552	-448	-61	75
2	-2	-1329	-1091	-715	872	-2008	-1631	-203	249
2	-1	-3228	-2579	-890	1108	-3488	-2781	-161	202
2	0	87	123	-73	74	-643	-460	47	-62
2	1	4	9	-6	3	-144	-116	15	-21
2	2	0	1	-1	0	-44	-31	4	-6
2	3	0	0	0	0	-12	-8	1	-2
2	4	0	0	0	0	-3	-2	0	0
2	5	0	0	0	0	-1	-1	0	0
3	-7	0	0	0	0	1	0	0	0
3	-6	0	0	0	1	3	0	0	0
3	-5	-2	-1	-1	3	10	-1	0	-1
3	-4	-14	-4	-5	13	43	-2	-1	-5
3	-3	-78	-28	-19	40	205	3	-1	-23
3	-2	1122	168	92	-631	1326	150	19	-158
3	-1	1088	-58	4	-276	1307	-27	-3	-34
3	0	-30	-9	3	-17	750	-12	1	27
3	1	-2	0	0	-1	64	-3	0	8
3	2	0	0	0	0	17	-1	0	2
3	3	0	0	0	0	5	0	0	1
3	4	0	0	0	0	1	0	0	0
4	-8	0	0	0	0	-1	1	0	0
4	-7	0	0	0	0	-5	2	0	1
4	-6	-1	0	0	2	-18	9	1	3
4	-5	-6	1	2	8	-64	32	5	10
4	-4	-29	8	9	30	-226	116	16	31
4	-3	-30	27	35	59	-772	425	53	94
4	-2	-7208	1002	510	1119	-3332	1759	185	351
4	-1	-5470	3675	145	257	-5916	3879	9	6
4	0	34	-10	5	17	-1200	794	-84	-127
4	1	2	0	0	1	-307	203	-25	-39
4	2	0	0	0	0	-81	54	-7	-11
4	3	0	0	0	0	-22	14	-2	-3
4	4	0	0	0	0	-6	4	-1	-1
4	5	0	0	0	0	-2	1	0	0
5	-7	0	0	0	0	-1	1	0	0
5	-6	-1	1	1	1	-2	2	0	0
5	-5	-3	2	2	2	-3	3	1	1
5	-4	11	-9	-6	-7	2	3	0	-1
5	-3	-27	32	21	17	-37	49	7	5
5	-2	-62	101	46	29	-64	102	9	5
5	-1	14	-27	7	4	0	-5	-1	-1
5	0	1	-1	0	0	0	-1	0	0
6	-5	1	-3	-2	-1	1	-3	-1	0
6	-4	-2	6	4	1	-1	1	0	0
6	-3	2	-14	-8	-1	1	-17	-2	0
6	-2	-1	-17	-7	0	-1	-19	-1	0
6	-1	0	1	-1	0	0	-3	0	0
6	0	0	0	0	0	0	-1	0	0
7	-6	0	-1	-1	0	0	-1	0	0
7	-5	0	2	1	0	0	1	0	0
7	-4	-1	-2	-1	0	0	0	0	0
7	-3	3	6	3	-2	3	6	1	0
7	-2	3	4	1	-1	3	5	0	0
7	-1	0	0	0	0	1	1	0	0
8	-5	0	0	0	0	-1	-1	0	0
8	-4	0	0	0	0	-1	-1	0	0
8	-3	-6	-3	-2	3	-7	-4	0	1
8	-2	-9	-3	0	1	-10	-4	0	0
8	-1	0	0	0	0	-2	-1	0	0
8	0	0	0	0	0	-1	0	0	0
9	-3	-1	0	0	0	-1	0	0	0

Table A-1. (Cont.)
 Secular Terms
 b) Earth on Mercury

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-879249	0	-14405460	0	-1586993	0
1	-89859	500770	500770	-151882	5064458	-3522511
2	268630	4701765	-4599161	262321	514207	-358939
3	83366	1426927	-1411205	82404	78383	-54814
4	22738	386334	-383483	22565	14166	-9917
5	6040	102240	-101672	6005	2813	-1971
6	1595	26940	-26820	1588	593	-416
7	421	7105	-7078	420	130	-91
8	111	1878	-1872	111	30	-21
9	30	498	-496	29	7	-5
10	8	132	-132	8	2	-1
11	2	35	-36	2	0	0
12	0	7	-12	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	3019	0	-47	0	-1184	0
1	-14565	899	-449	-7282	3778	-2628
2	-742	46	-46	-742	384	-268
3	-76	5	-7	-113	58	-41
4	-10	1	-1	-21	11	-7
5	-2	0	0	-4	2	-1
6	0	0	0	-1	0	0

Table A-1. (Cont.)
Periodic Terms
c) Mars on Mercury

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	307	0	18	0	60	0	0	0		
0	1	-452	-4	11	-420	0	0	0	0		
0	2	135	17	-17	135	-3	-14	0	0		
0	3	22	2	-2	22	0	-2	0	0		
0	4	3	0	0	3	0	0	0	0		
1	-8	0	-1	-1	0	0	0	0	0		
1	-7	2	-4	-4	-2	0	0	0	0		
1	-6	9	-15	-15	-9	0	0	0	0		
1	-5	35	-59	-59	-35	0	0	0	0		
1	-4	136	-226	-225	-135	0	1	0	0		
1	-3	517	-864	-855	-512	0	9	0	0		
1	-2	1855	-3092	-3032	-1825	8	65	0	0		
1	-1	3238	-2304	-1810	-3247	-217	352	-1	2		
1	0	-2783	6961	-7251	-3772	87	-177	0	-1		
1	1	-3287	2822	-2784	-3215	325	68	2	0		
1	2	-826	613	-608	-818	32	5	0	0		
1	3	-204	145	-144	-203	5	0	0	0		
1	4	-51	35	-35	-51	0	0	0	0		
1	5	-13	9	-9	-13	0	0	0	0		
1	6	-3	2	-2	-3	0	0	0	0		
2	-8	-3	-2	-2	3	0	0	0	0		
2	-7	-13	-7	-7	13	0	0	0	0		
2	-6	-48	-25	-25	48	0	0	0	0		
2	-5	-178	-93	-92	177	0	0	0	0		
2	-4	-642	-340	-337	637	0	3	0	0		
2	-3	-2169	-1181	-1163	2143	0	17	0	0		
2	-2	-5541	-3236	-3131	5461	24	102	0	1		
2	-1	2769	862	-1831	3177	49	783	0	4		
2	0	13595	7586	-7593	13516	-4	-353	0	-2		
2	1	2121	1478	-1468	2114	30	-74	0	0		
2	2	405	297	-296	403	3	-9	0	0		
2	3	90	68	-68	90	0	-1	0	0		
2	4	21	16	-16	21	0	0	0	0		
2	5	5	4	-4	5	0	0	0	0		
2	6	1	1	-1	1	0	0	0	0		
3	-8	-1	0	0	1	0	0	0	0		
3	-7	-5	-2	-2	5	0	0	0	0		
3	-6	-21	-5	-5	21	0	0	0	0		
3	-5	-80	-15	-16	79	0	0	0	0		
3	-4	-301	-38	-42	297	0	0	0	0		
3	-3	-1070	-55	-94	1037	8	7	0	0		
3	-2	-2563	-164	-641	2122	78	34	0	0		
3	-1	1875	-213	106	2112	89	197	0	1		
3	0	5171	805	-803	5147	-47	-108	0	-1		
3	1	856	158	-157	852	-4	-20	0	0		
3	2	172	33	-32	171	0	-2	0	0		
3	3	39	8	-8	39	0	0	0	0		
3	4	9	2	-2	9	0	0	0	0		
3	5	2	0	0	2	0	0	0	0		
4	-7	-2	0	0	2	0	0	0	0		
4	-6	-7	1	1	6	0	0	0	0		
4	-5	-27	5	6	25	0	0	0	0		
4	-4	-108	24	29	98	0	0	0	0		
4	-3	-385	136	166	328	4	5	0	0		
4	-2	-797	362	-73	693	51	-10	0	0		
4	-1	697	-490	496	755	31	35	0	0		
4	0	1458	-329	327	1450	-24	-22	0	0		
4	1	246	-53	53	245	-3	-4	0	0		
4	2	51	-11	11	51	0	0	0	0		
4	3	12	-2	2	12	0	0	0	0		
4	4	3	0	0	3	0	0	0	0		

Table A-1. (Cont.)
c) Mars on Mercury

5	-6	-1	1	2	2	0	0	0	0
5	-5	-6	5	7	7	0	0	0	0
5	-4	-29	21	29	30	0	0	0	0
5	-3	-118	107	121	60	3	3	0	0
5	-2	-185	236	40	237	20	-17	0	0
5	-1	148	-317	324	159	7	6	0	0
5	0	355	-261	259	353	-9	-2	0	0
5	1	62	-45	45	61	0	0	0	0
5	2	13	-9	9	13	0	0	0	0
5	3	3	-2	2	3	0	0	0	0
6	-6	0	1	0	0	0	0	0	0
6	-5	0	3	4	1	0	0	0	0
6	-4	-4	11	20	7	0	0	0	0
6	-3	-25	65	59	-7	2	0	0	0
6	-2	-31	116	59	83	4	-12	0	0
6	-1	-15	-151	154	-14	1	2	0	0
6	0	75	-139	138	75	-3	0	0	0
6	1	14	-25	25	14	0	0	0	0
6	2	3	-5	5	3	0	0	0	0
6	3	0	-1	1	0	0	0	0	0
7	-5	2	3	2	0	0	0	0	0
7	-4	3	8	14	-3	0	0	0	0
7	-3	9	45	36	-20	0	0	0	0
7	-2	2	91	80	25	0	-8	0	0
7	-1	-55	-73	73	-55	0	2	0	0
7	0	6	-109	108	6	0	0	0	0
7	1	1	-21	21	1	0	0	0	0
7	2	0	-5	5	0	0	0	0	0
7	3	0	-1	1	0	0	0	0	0
8	-5	-1	2	2	2	0	0	0	0
8	-4	-7	6	9	6	0	0	0	0
8	-3	-17	38	34	14	0	0	0	0
8	-2	81	239	242	-80	5	7	0	0
8	-1	96	36	-37	96	-2	-2	0	0
8	0	-65	-229	226	-65	0	0	0	0
8	1	-14	-47	47	-14	0	0	0	0
8	2	-3	-11	11	-3	0	0	0	0
8	3	0	-3	3	0	0	0	0	0
9	-4	-1	0	0	0	0	0	0	0
9	-3	-1	1	0	1	0	0	0	0
9	-2	1	0	2	0	0	0	0	0
9	-1	4	0	0	4	0	0	0	0

Table A-1. (Cont.)
c) Mars on Mercury

J	K	NDZ ----- (IN UNITS OF 10**(-4))		NU SECONDS OF ARC)-----		D (LONG.)		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-2	0	0	0	0	0
0	1	0	0	2	0	0	0	0	0
1	-4	0	0	0	0	-1	-1	0	0
1	-3	0	0	0	0	-4	-2	0	1
1	-2	-2	-2	-2	2	-14	-8	-1	2
1	-1	-53	-24	-11	24	-57	-31	-3	5
1	0	-16	-30	1	1	-27	-36	1	-1
1	1	-1	-4	2	-1	-7	-11	1	-1
1	2	0	0	0	0	-2	-3	0	0
1	3	0	0	0	0	0	-1	0	0
2	-5	0	0	0	0	0	1	0	0
2	-4	0	0	1	0	-2	4	1	0
2	-3	-1	3	3	1	-7	13	2	1
2	-2	-13	26	19	9	-24	46	6	3
2	-1	-56	99	43	24	-58	103	8	5
2	0	0	-7	4	2	-12	15	-1	-1
2	1	0	-1	0	0	-3	4	0	0
2	2	0	0	0	0	-1	1	0	0
3	-4	0	0	0	0	-1	1	0	0
3	-3	-1	0	1	1	-2	5	1	0
3	-2	1	16	10	0	-1	23	3	0
3	-1	-7	38	15	2	-7	40	3	0
3	0	0	-2	1	0	-1	7	-1	0
3	1	0	0	0	0	0	2	0	0
4	-3	-1	0	0	1	0	2	0	0
4	-2	4	5	3	-2	4	8	1	-1
4	-1	2	11	4	-1	2	12	1	0
4	0	0	0	0	0	0	2	0	0
4	1	0	0	0	0	0	1	0	0
5	-3	0	0	0	0	0	1	0	0
5	-2	2	1	1	-1	3	2	0	0
5	-1	2	3	1	-1	2	3	0	0
5	0	0	0	0	0	0	1	0	0
6	-2	1	0	0	-1	1	0	0	0
6	-1	1	1	0	0	1	1	0	0
7	-2	1	0	0	0	1	0	0	0
7	-1	1	0	0	0	1	0	0	0
8	-2	0	1	0	0	0	1	0	0
8	-1	3	-1	0	0	3	-1	0	0
8	0	0	0	0	0	1	0	0	0

Table A-1. (Cont.)

Secular Terms

c) Mars on Mercury

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	46344	0	-390025	0	-30087	0
1	4736	13558	13558	8005	96016	-68736
2	-14159	127299	-124521	-13827	9749	-7004
3	-4394	38634	-38208	-4343	1486	-1070
4	-1199	10460	-10383	-1189	269	-194
5	-318	2768	-2753	-317	53	-38
6	-84	729	-726	-84	11	-8
7	-22	192	-192	-22	2	-2
8	-6	51	-51	-6	0	0
9	-2	13	-13	-2	0	0
10	0	4	-4	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	82	0	2	0	-22	0
1	-394	-47	24	-197	72	-51
2	-20	-2	2	-20	7	-5
3	-2	0	0	-3	1	-1
4	0	0	0	-1	0	0

Table A-1. (Cont.)
 Periodic Terms
 d) Jupiter on Mercury

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	19926	0	21	0	4613	0	25	0		
0	1	-29889	993	960	-28650	0	0	0	0		
0	2	8287	-18	40	8338	-404	-683	-2	-4		
0	3	1316	-156	154	1324	-57	-104	0	-1		
0	4	185	-62	61	186	-9	-18	0	0		
0	5	22	-19	19	22	-2	-3	0	0		
0	6	0	-6	6	0	0	0	0	0		
0	7	0	-2	2	0	0	0	0	0		
1	-10	0	-9	-10	0	0	0	0	0		
1	-9	1	-35	-35	-2	0	0	0	0		
1	-8	6	-131	-131	-6	0	0	0	0		
1	-7	25	-497	-495	-25	0	2	0	0		
1	-6	103	-1888	-1880	-103	-4	9	0	0		
1	-5	436	-7190	-7151	-436	-17	42	0	0		
1	-4	1930	-27323	-27128	-1930	-83	212	0	1		
1	-3	9231	-102061	-100988	-9239	-444	1178	-2	6		
1	-2	51437	-347634	-340758	-51618	-2725	7766	-15	41		
1	-1	443874	-248422	-191052	-451611	-34120	74256	-182	396		
1	0	208353	881365	-918954	20932	-2253	-26112	-12	-139		
1	1	-415720	339139	-335048	-404385	46794	824	249	4		
1	2	-115099	72130	-71597	-113781	4741	23	25	0		
1	3	-28757	16759	-16667	-28543	725	0	4	0		
1	4	-7228	4071	-4053	-7188	131	0	1	0		
1	5	-1839	1015	-1012	-1831	26	0	0	0		
1	6	-473	258	-257	-471	6	0	0	0		
1	7	-123	66	-66	-122	1	0	0	0		
1	8	-32	17	-17	-32	0	0	0	0		
1	9	-8	4	-5	-8	0	0	0	0		
1	10	-2	-1	-4	-2	0	0	0	0		
2	-10	-29	38	39	30	0	0	0	0		
2	-9	-109	145	145	109	0	0	0	0		
2	-8	-411	546	545	410	2	0	0	0		
2	-7	-1548	2057	2049	1542	9	0	0	0		
2	-6	-5838	7756	7721	5811	40	0	0	0		
2	-5	-21980	29199	29032	21854	191	-2	1	0		
2	-4	-82044	108985	108161	81419	965	-10	5	0		
2	-3	-296677	394161	389840	293377	5350	-55	29	0		
2	-2	-934027	1242855	1219211	915598	35088	-515	187	-3		
2	-1	-41413	113197	152749	68388	335412	-4871	1787	-26		
2	0	2720446	-3572717	3579282	2704537	-103283	1172	-550	6		
2	1	428986	-622613	619877	428124	-29295	647	-156	3		
2	2	76294	-116614	116103	76049	-3113	63	-17	0		
2	3	16596	-25911	25812	16544	-484	10	-3	0		
2	4	3895	-6153	6132	3884	-88	2	0	0		
2	5	951	-1514	1509	949	-18	0	0	0		
2	6	238	-381	380	238	-4	0	0	0		
2	7	60	-97	97	61	0	0	0	0		
2	8	15	-24	26	16	0	0	0	0		
2	9	2	-3	10	6	0	0	0	0		
2	10	-8	10	13	10	0	0	0	0		
3	-10	-2	5	5	3	0	0	0	0		
3	-9	-10	18	19	11	0	0	0	0		
3	-8	-39	70	69	39	0	0	0	0		
3	-7	-145	262	261	144	0	0	0	0		
3	-6	-530	989	985	529	4	-2	0	0		
3	-5	-1916	3723	3700	1915	18	-8	0	0		
3	-4	-6775	13877	13761	6802	90	-40	0	0		
3	-3	-22844	49934	49273	23350	497	-238	3	-1		
3	-2	-69269	153896	149432	77366	3153	-1778	17	-9		
3	-1	-2885	3019	27602	4058	33431	-9862	178	-53		
3	0	212308	-434178	434633	210863	-10627	3159	-57	17		
3	1	32703	-74716	74393	32645	-3059	687	-16	4		
3	2	5808	-14016	13955	5790	-328	73	-2	0		
3	3	1261	-3116	3104	1257	-51	11	0	0		
3	4	296	-740	737	295	-9	2	0	0		
3	5	72	-182	182	72	-2	0	0	0		
3	6	18	-46	46	18	0	0	0	0		
3	7	5	-12	12	5	0	0	0	0		
3	8	1	-3	3	1	0	0	0	0		
3	9	0	0	1	0	0	0	0	0		
3	10	-2	1	2	2	0	0	0	0		

Table A-1. (Cont.)
d) Jupiter on Mercury

4	-9	0	2	1	1	0	0	0	0
4	-8	-3	6	6	3	0	0	0	0
4	-7	-11	23	23	11	0	0	0	0
4	-6	-36	91	89	37	0	0	0	0
4	-5	-116	351	341	120	1	-2	0	0
4	-4	-338	1334	1268	372	7	-10	0	0
4	-3	-869	4741	4359	1133	38	-59	0	0
4	-2	-2571	13614	13723	4614	120	-289	1	-2
4	-1	-690	-511	3030	-613	2367	-1491	13	-8
4	0	10224	-38584	38595	10110	-774	495	-4	3
4	1	1455	-6536	6508	1455	-230	102	-1	1
4	2	250	-1228	1222	250	-25	11	0	0
4	3	53	-273	272	53	-4	2	0	0
4	4	12	-65	65	12	0	0	0	0
4	5	3	-16	16	3	0	0	0	0
4	6	0	-4	4	0	0	0	0	0
4	7	0	-1	1	0	0	0	0	0
5	-7	0	2	1	0	0	0	0	0
5	-6	-3	7	6	2	0	0	0	0
5	-5	-7	31	25	6	0	0	0	0
5	-4	-8	120	94	8	1	-2	0	0
5	-3	45	393	312	39	2	-11	0	0
5	-2	57	993	1124	202	-9	-28	0	0
5	-1	-128	-68	244	-157	136	-150	1	-1
5	0	198	-2941	2940	190	-45	51	0	0
5	1	14	-491	489	15	-15	10	0	0
5	2	1	-92	92	1	-2	1	0	0
5	3	0	-21	20	0	0	0	0	0
5	4	0	-5	5	0	0	0	0	0
5	5	0	-1	1	0	0	0	0	0
6	-5	0	3	1	0	0	0	0	0
6	-4	0	11	4	-1	0	0	0	0
6	-3	14	28	20	3	0	-1	0	0
6	-2	19	61	87	3	-2	-2	0	0
6	-1	-16	-3	14	-20	6	-12	0	0
6	0	-24	-202	202	-24	-2	4	0	0
6	1	-5	-33	33	-5	0	0	0	0
6	2	-1	-6	6	-1	0	0	0	0
6	3	0	-1	1	0	0	0	0	0
7	-4	0	1	0	0	0	0	0	0
7	-3	2	2	1	0	0	0	0	0
7	-2	2	3	6	0	0	0	0	0
7	-1	-2	0	0	-2	0	0	0	0
7	0	-4	-13	13	-4	0	0	0	0
7	1	0	-2	2	0	0	0	0	0

Table A-1. (Cont.)
d) Jupiter on Mercury

J	K	NDZ ----- (IN UNITS OF 10**(-4)) -----		NU SECONDS OF ARC) -----		D (LONG.) -----		D LOG(R) (IN UNITS OF 10**(-9)) -----	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-146	0	0	0	-31	0
0	1	-1	3	122	0	0	0	25	0
0	2	6	-13	20	4	6	-13	4	1
0	3	1	-2	3	1	2	-4	1	0
0	4	0	0	1	0	1	-1	0	0
1	-8	0	0	0	0	-1	0	0	0
1	-7	0	0	0	0	-3	0	0	0
1	-6	0	0	0	0	-9	0	0	1
1	-5	-1	0	0	2	-34	-1	0	5
1	-4	-5	0	1	10	-127	-4	-1	18
1	-3	-36	3	5	53	-474	-14	-2	64
1	-2	-355	29	33	345	-1791	-50	-7	223
1	-1	-6558	855	419	3231	-6977	-137	-17	708
1	0	-1659	-4700	128	308	-3042	-4667	-6	-75
1	1	-105	-690	352	-54	-792	-1614	168	-90
1	2	-6	-36	36	-6	-205	-410	51	-27
1	3	-1	-4	6	-1	-55	-108	15	-8
1	4	0	0	1	0	-15	-29	4	-2
1	5	0	0	0	0	-4	-8	1	-1
1	6	0	0	0	0	-1	-2	0	0
1	7	0	0	0	0	0	-1	0	0
2	-9	0	0	0	0	1	1	0	0
2	-8	0	0	0	0	3	2	0	0
2	-7	0	0	0	-1	11	8	1	-2
2	-6	1	1	2	-2	40	30	5	-6
2	-5	5	4	8	-11	148	112	17	-22
2	-4	31	23	42	-57	546	411	59	-79
2	-3	230	172	232	-309	2019	1520	209	-278
2	-2	2204	1662	1459	-1933	7491	5647	713	-946
2	-1	25931	19676	9671	-12748	26139	19731	1969	-2609
2	0	-1223	-1395	997	-1296	4177	2686	-224	297
2	1	-104	-156	80	-53	1025	605	-85	136
2	2	-3	-7	7	-3	277	166	-24	39
2	3	0	-1	1	0	75	45	-7	11
2	4	0	0	0	0	20	12	-2	3
2	5	0	0	0	0	6	3	-1	1
2	6	0	0	0	0	2	1	0	0
3	-7	0	0	0	0	1	1	0	0
3	-6	0	0	0	0	5	3	1	-1
3	-5	1	1	2	-1	19	12	2	-3
3	-4	4	7	9	-7	70	42	6	-10
3	-3	29	40	40	-40	259	144	21	-36
3	-2	329	118	110	-276	971	436	54	-123
3	-1	3147	1543	747	-1534	3183	1545	152	-312
3	0	-156	-116	77	-154	502	203	-18	37
3	1	-13	-13	7	-7	123	46	-6	16
3	2	0	-1	1	0	33	13	-2	5
3	3	0	0	0	0	9	3	-1	1
3	4	0	0	0	0	2	1	0	0
3	5	0	0	0	0	1	0	0	0
4	-5	0	0	0	0	1	1	0	0
4	-4	0	1	2	0	6	4	1	-1
4	-3	5	6	5	-5	26	10	2	-4
4	-2	33	0	2	-27	90	16	2	-11
4	-1	280	76	35	-135	284	75	7	-27
4	0	-15	-7	4	-13	44	9	-1	3
4	1	-1	-1	0	-1	11	2	0	1
4	2	0	0	0	0	3	1	0	0
4	3	0	0	0	0	1	0	0	0
5	-3	1	1	1	-1	2	1	0	0
5	-2	2	-1	-1	-2	7	-1	0	-1
5	-1	21	2	1	-10	22	1	0	-2
5	0	-1	0	0	-1	3	0	0	0
5	1	0	0	0	0	1	0	0	0
6	-1	1	0	0	-1	1	0	0	0

Table A-1. (Cont.)
 Secular Terms
 d) Jupiter on Mercury

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-246229	0	-24417449	0	-2139500	0
1	-25164	848811	848811	-42534	6827635	-6472232
2	75228	7969555	-7795641	73461	693227	-659511
3	23346	2418660	-2392011	23077	105672	-100715
4	6368	654841	-650008	6319	19098	-18222
5	1691	173298	-172335	1682	3793	-3621
6	447	45664	-45461	445	800	-764
7	118	12042	-11998	118	176	-168
8	31	3183	-3173	31	40	-38
9	8	844	-842	8	9	-9
10	2	224	-224	2	2	-2
11	0	59	-61	0	0	0
12	0	12	-20	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	5117	0	-13	0	-1596	0
1	-24687	252	-126	-12344	5094	-4828
2	-1258	13	-13	-1258	517	-492
3	-128	1	-2	-192	79	-75
4	-17	0	0	-35	14	-14
5	-3	0	0	-7	3	-3
6	0	0	0	-1	1	-1

Table A-1. (Cont.)

Periodic Terms

e) Saturn on Mercury

		DX				DY				DZ				U/COS(I)	
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)					
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	955	0	-9	0	270	0	1	0						
0	1	-1418	57	47	-1401	0	0	0	0						
0	2	393	-11	12	396	-26	-26	0	0						
0	3	59	-10	10	60	-4	-4	0	0						
0	4	7	-3	3	8	0	0	0	0						
0	5	0	-1	1	0	0	0	0	0						
1	-8	-6	4	4	4	0	0	0	0						
1	-7	-19	15	15	18	0	0	0	0						
1	-6	-70	58	57	69	0	0	0	0						
1	-5	-258	219	218	256	0	2	0	0						
1	-4	-931	831	825	922	0	10	0	0						
1	-3	-3115	3088	3056	3064	0	57	0	0						
1	-2	-7107	10389	10181	6772	0	370	0	2						
1	-1	59954	5859	4059	-63006	-105	3796	-1	20						
1	0	74249	-27474	28982	-43427	-987	-2160	-5	-12						
1	1	-51629	-8755	8649	-49906	3140	3010	17	16						
1	2	-15655	-1926	1911	-15459	317	303	7	2						
1	3	-3981	-453	450	-3950	48	46	0	0						
1	4	-1008	-111	110	-1002	9	8	0	0						
1	5	-258	-28	28	-256	2	2	0	0						
1	6	-66	-7	7	-66	0	0	0	0						
1	7	-18	-2	2	-17	0	0	0	0						
1	8	-6	0	2	-3	0	0	0	0						
2	-8	62	-36	-37	-64	0	0	0	0						
2	-7	237	-137	-137	-237	-1	0	0	0						
2	-6	899	-519	-517	-895	-5	0	0	0						
2	-5	3401	-1965	-1954	-3382	-22	-4	0	0						
2	-4	12788	-7392	-7337	-12693	-112	-21	-1	0						
2	-3	46854	-27106	-26808	-46339	-617	-117	-3	-1						
2	-2	152024	-88144	-86331	-148890	-4048	-762	-22	-4						
2	-1	23083	-16693	-6814	-6078	-39424	-7404	-210	-39						
2	0	-446358	256155	-257361	-446268	11530	2173	61	12						
2	1	-75956	46963	-46723	-75681	3736	669	20	4						
2	2	-13938	8885	-8843	-13881	390	70	2	0						
2	3	-3073	1982	-1974	-3062	60	11	0	0						
2	4	-726	472	-470	-724	11	2	0	0						
2	5	-178	116	-116	-178	2	0	0	0						
2	6	-44	29	-30	-46	0	0	0	0						
2	7	-7	5	-10	-16	0	0	0	0						
2	8	15	-8	-12	-21	0	0	0	0						
3	-8	8	-4	-5	-8	0	0	0	0						
3	-7	30	-16	-17	-30	0	0	0	0						
3	-6	114	-62	-62	-114	0	0	0	0						
3	-5	431	-233	-232	-429	-2	0	0	0						
3	-4	1611	-868	-863	-1600	-12	-3	0	0						
3	-3	5849	-3144	-3124	-5799	-69	-17	0	0						
3	-2	18770	-10109	-10077	-18565	-445	-109	-2	-1						
3	-1	2335	-1774	-957	-958	-4513	-1036	-24	-6						
3	0	-55163	29430	-29582	-55064	1338	311	7	2						
3	1	-9227	5404	-5376	-9197	438	86	2	0						
3	2	-1681	1027	-1022	-1674	46	9	0	0						
3	3	-369	230	-229	-368	7	1	0	0						
3	4	-87	55	-54	-87	1	0	0	0						
3	5	-21	13	-13	-21	0	0	0	0						
3	6	-5	3	-3	-6	0	0	0	0						
3	7	0	0	-1	-2	0	0	0	0						
3	8	2	-1	-2	-3	0	0	0	0						
4	-7	3	-2	-2	-3	0	0	0	0						
4	-6	11	-6	-6	-11	0	0	0	0						
4	-5	43	-22	-22	-43	0	0	0	0						
4	-4	157	-79	-79	-157	0	0	0	0						
4	-3	564	-279	-283	-564	-5	-2	0	0						
4	-2	1794	-893	-914	-1802	-36	-11	0	0						
4	-1	192	-150	-95	-117	-400	-108	-2	-1						
4	0	-5281	2617	-2631	-5269	120	33	1	0						
4	1	-880	481	-478	-877	40	9	0	0						
4	2	-160	92	-91	-160	4	0	0	0						
4	3	-35	21	-20	-35	0	0	0	0						
4	4	-8	5	-5	-8	0	0	0	0						
4	5	-2	1	-1	-2	0	0	0	0						
5	-6	1	0	0	-1	0	0	0	0						
5	-5	4	-2	-2	-4	0	0	0	0						
5	-4	14	-6	-7	-14	0	0	0	0						
5	-3	49	-22	-24	-50	0	0	0	0						
5	-2	155	-71	-75	-159	-3	-1	0	0						
5	-1	15	-12	-8	-12	-32	-10	0	0						
5	0	-458	211	-212	-457	10	3	0	0						
5	1	-76	39	-39	-76	3	0	0	0						
5	2	-14	7	-7	-14	0	0	0	0						
5	3	-3	2	-2	-3	0	0	0	0						
6	-4	1	0	0	-1	0	0	0	0						
6	-3	4	-2	-2	-4	0	0	0	0						
6	-2	13	-5	-6	-13	0	0	0	0						
6	-1	1	0	0	-1	-2	0	0	0						
6	0	-38	16	-16	-38	0	0	0	0						
6	1	-6	3	-3	-6	0	0	0	0						
6	2	-1	0	0	-1	0	0	0	0						
7	-2	1	0	0	-1	0	0	0	0						
7	0	-3	1	-1	-3	0	0	0	0						

Table A-1. (Cont.)
e) Saturn on Mercury

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-7	0	0	0	-1	0
0	1	0	0	6	0	0	0	1	0
0	2	0	-1	1	0	0	-1	0	0
1	-5	0	0	0	0	1	1	0	0
1	-4	0	0	1	0	4	5	1	-1
1	-3	1	2	3	-2	15	20	3	-2
1	-2	11	23	23	-11	55	75	9	-7
1	-1	205	429	213	-102	214	289	29	-22
1	0	31	-676	31	-10	74	-611	-5	2
1	1	4	-114	58	2	22	-231	24	2
1	2	0	-6	6	0	6	-59	7	1
1	3	0	-1	1	0	2	-15	2	0
1	4	0	0	0	0	0	-4	1	0
1	5	0	0	0	0	0	-1	0	0
2	-7	0	0	0	0	-1	-1	0	0
2	-6	0	0	0	0	-3	-5	-1	0
2	-5	0	0	-1	1	-10	-17	-3	1
2	-4	-2	-3	-6	3	-36	-62	-9	5
2	-3	-12	-22	-31	18	-133	-231	-32	18
2	-2	-120	-209	-196	112	-500	-867	-109	63
2	-1	-1863	-3239	-1609	925	-1875	-3246	-330	191
2	0	65	174	-167	96	-321	-496	36	-20
2	1	5	17	-9	3	-80	-118	16	-10
2	2	0	1	-1	0	-21	-32	5	-3
2	3	0	0	0	0	-6	-9	1	-1
2	4	0	0	0	0	-2	-2	0	0
2	5	0	0	0	0	0	-1	0	0
3	-6	0	0	0	0	0	-1	0	0
3	-5	0	0	0	0	-1	-2	0	0
3	-4	0	0	-1	0	-4	-8	-1	1
3	-3	-2	-3	-4	3	-16	-30	-4	2
3	-2	-15	-28	-26	14	-58	-109	-14	7
3	-1	-214	-400	-198	106	-216	-401	-41	22
3	0	7	23	-20	11	-37	-60	4	-2
3	1	1	2	-1	0	-9	-14	2	-1
3	2	0	0	0	0	-2	-4	1	0
3	3	0	0	0	0	-1	-1	0	0
4	-4	0	0	0	0	0	-1	0	0
4	-3	0	0	-1	0	-2	-3	0	0
4	-2	-1	-3	-3	1	-5	-11	-1	1
4	-1	-19	-38	-19	9	-19	-38	-4	2
4	0	1	2	-2	1	-3	-6	0	0
4	1	0	0	0	0	-1	-1	0	0
5	-2	0	0	0	0	0	-1	0	0
5	-1	-2	-3	-2	1	-2	-3	0	0

Table A-1. (Cont.)
 Secular Terms
 e) Saturn on Mercury

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-40876	0	-1157272	0	-86382	0
1	-4178	40230	40230	-7061	275666	-388072
2	12489	377720	-369477	12195	27989	-39544
3	3876	114633	-113370	3831	4267	-6039
4	1057	31036	-30807	1049	771	-1093
5	281	8213	-8168	279	153	-217
6	74	2164	-2155	74	32	-46
7	20	571	-569	20	7	-10
8	5	151	-150	5	2	-2
9	1	40	-40	1	0	0
10	0	11	-11	0	0	0
11	0	3	-3	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	242	0	-2	0	-64	0
1	-1170	42	-21	-585	206	-290
2	-60	2	-2	-60	21	-30
3	-6	0	0	-9	3	-5
4	-1	0	0	-2	1	-1

Table A-1. (Cont.)
Periodic Terms
f) Uranus on Mercury

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	18	0	0	0	3	0	0	0	
0	1	-27	0	0	-26	0	0	0	0	
0	2	8	0	0	8	0	0	0	0	
0	3	1	0	0	1	0	0	0	0	
1	-7	2	0	0	-2	0	0	0	0	
1	-6	7	3	3	-6	0	0	0	0	
1	-5	25	10	10	-25	0	0	0	0	
1	-4	97	39	39	-97	0	0	0	0	
1	-3	377	146	145	-374	-4	1	0	0	
1	-2	1420	503	493	-1400	-23	9	0	0	
1	-1	3621	446	351	-3441	-228	91	-1	0	
1	0	-1331	-1251	1299	-2919	31	-114	0	-1	
1	1	-3751	-573	566	-3657	129	275	1	1	
1	2	-1011	-120	119	-1000	13	28	0	0	
1	3	-250	-28	27	-248	2	4	0	0	
1	4	-63	-7	7	-62	0	0	0	0	
1	5	-16	-2	2	-16	0	0	0	0	
1	6	-4	0	0	-4	0	0	0	0	
1	7	-1	0	0	-1	0	0	0	0	
2	-8	-4	0	0	4	0	0	0	0	
2	-7	-14	2	2	14	0	0	0	0	
2	-6	-53	6	6	53	0	0	0	0	
2	-5	-201	24	24	200	0	0	0	0	
2	-4	-758	90	89	753	4	5	0	0	
2	-3	-2796	333	330	2765	20	26	0	0	
2	-2	-9193	1108	1085	8997	132	171	1	1	
2	-1	-1698	439	248	75	1298	1672	7	9	
2	0	27208	-3084	3182	27182	-372	-484	-2	-3	
2	1	4632	-769	762	4616	-126	-144	-1	-1	
2	2	844	-161	160	840	-13	-15	0	0	
2	3	185	-37	37	185	-2	-2	0	0	
2	4	44	-9	9	44	0	0	0	0	
2	5	11	-2	2	11	0	0	0	0	
2	6	3	0	0	3	0	0	0	0	
2	8	0	0	0	1	0	0	0	0	
3	-7	-2	0	0	2	0	0	0	0	
3	-6	-6	0	0	6	0	0	0	0	
3	-5	-23	1	1	22	0	0	0	0	
3	-4	-85	5	5	85	0	0	0	0	
3	-3	-314	19	19	310	2	3	0	0	
3	-2	-1028	63	64	1006	13	20	0	0	
3	-1	-190	36	24	26	129	195	1	1	
3	0	3028	-170	180	3029	-37	-57	0	0	
3	1	575	-54	53	523	-13	-17	0	0	
3	2	96	-12	12	96	-1	-2	0	0	
3	3	21	-3	3	21	0	0	0	0	
3	4	5	0	0	5	0	0	0	0	
3	5	1	0	0	1	0	0	0	0	
4	-5	-2	0	0	2	0	0	0	0	
4	-4	-7	0	0	7	0	0	0	0	
4	-3	-27	0	0	27	0	0	0	0	
4	-2	-89	0	0	87	0	2	0	0	
4	-1	-16	2	2	3	10	18	0	0	
4	0	262	0	0	262	-3	-5	0	0	
4	1	46	-2	2	46	-1	-2	0	0	
4	2	8	0	0	8	0	0	0	0	
4	3	2	0	0	2	0	0	0	0	
5	-3	-2	0	0	2	0	0	0	0	
5	-2	-7	0	0	7	0	0	0	0	
5	-1	-1	0	0	0	0	1	0	0	
5	0	21	1	-1	21	0	0	0	0	
5	1	4	0	0	4	0	0	0	0	
6	0	2	0	0	2	0	0	0	0	

Table A-1. (Cont.)
f) Uranus on Mercury

J	K	NDZ ----- (IN UNITS OF 10**(-4))		NU SECONDS OF ARC)-----		D (LONG.) -----		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
1	-3	0	0	0	0	1	-2	0	0
1	-2	0	-1	-1	0	3	-6	-1	0
1	-1	9	-15	-8	-5	10	-23	-2	-1
1	0	3	-35	0	0	5	-39	0	0
1	1	0	-6	3	0	1	-14	1	0
1	2	0	0	0	0	0	-3	0	0
1	3	0	0	0	0	0	-1	0	0
2	-5	0	0	0	0	0	1	0	0
2	-4	0	0	0	0	0	4	1	0
2	-3	0	1	2	0	2	14	2	0
2	-2	1	11	11	-1	6	51	6	-1
2	-1	23	197	98	-11	23	197	20	-2
2	0	1	-11	10	-1	6	30	-2	0
2	1	0	-1	1	0	2	7	-1	0
2	2	0	0	0	0	0	2	0	0
2	3	0	0	0	0	0	1	0	0
3	-3	0	0	0	0	0	2	0	0
3	-2	0	1	1	0	0	6	1	0
3	-1	1	22	11	-1	1	22	2	0
3	0	0	-1	1	0	0	3	0	0
3	1	0	0	0	0	0	1	0	0
4	-2	0	0	0	0	0	1	0	0
4	-1	0	2	1	0	0	2	0	0

Secular Terms
f) Uranus on Mercury

J	DX (IN UNITS OF 10**(-16))		DY (IN UNITS OF 10**(-16))		DZ	
	COS	SIN	COS	SIN	COS	SIN
0	-741	0	-22456	0	-2099	0
1	-76	781	781	-128	6697	-4995
2	226	7329	-7169	221	680	-509
3	70	2224	-2200	69	104	-78
4	19	602	-598	19	19	-14
5	5	159	-158	5	4	-3
6	1	42	-42	1	0	0
7	0	11	-11	0	0	0
8	0	3	-3	0	0	0

J	NDZ (THE TERMS ARE IN UNITS OF 10**(-6) SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)		NU		U/COS(I)	
	COS	SIN	COS	SIN	COS	SIN
0	5	0	-0	0	-2	0
1	-23	1	0	-11	5	-4
2	-1	0	0	-1	1	0

Table A-1. (Cont.)
 Periodic Terms
 g) Neptune on Mercury

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	6	0	0	0	2	0	0	0		
0	1	-8	0	0	-8	0	0	0	0		
0	2	2	0	0	2	0	0	0	0		
1	-5	-2	-3	-3	2	0	0	0	0		
1	-4	-9	-12	-12	9	0	0	0	0		
1	-3	-32	-44	-44	32	0	0	0	0		
1	-2	-94	-150	-147	91	0	6	0	0		
1	-1	221	-98	-69	-248	-4	56	0	0		
1	0	490	403	-405	366	-5	-17	0	0		
1	1	-170	139	-138	-164	21	-3	0	0		
1	2	-56	27	-27	-55	2	0	0	0		
1	3	-14	6	-6	-14	0	0	0	0		
1	4	-4	1	-1	-4	0	0	0	0		
2	-8	0	2	2	-1	0	0	0	0		
2	-7	4	8	8	-4	0	0	0	0		
2	-6	14	29	28	-14	0	0	0	0		
2	-5	54	108	108	-54	0	0	0	0		
2	-4	204	409	406	-203	1	-4	0	0		
2	-3	756	1511	1494	-748	8	-21	0	0		
2	-2	2503	4983	4876	-2449	51	-136	0	-1		
2	-1	647	926	-40	-167	501	-1333	3	-7		
2	0	-7283	-14811	14781	-7351	-144	380	-1	2		
2	1	-1411	-2482	2475	-1403	-42	127	0	1		
2	2	-272	-448	447	-271	-4	13	0	0		
2	3	-61	-98	98	-61	0	2	0	0		
2	4	-15	-23	23	-15	0	0	0	0		
2	5	-4	-6	6	-4	0	0	0	0		
2	6	0	-1	1	0	0	0	0	0		
3	-5	1	2	2	-1	0	0	0	0		
3	-4	4	6	6	-4	0	0	0	0		
3	-3	15	24	23	-15	0	0	0	0		
3	-2	51	77	76	-50	0	-2	0	0		
3	-1	12	14	0	-3	4	-22	0	0		
3	0	-148	-231	230	-149	-1	6	0	0		
3	1	-28	-38	38	-28	0	2	0	0		
3	2	-5	-7	7	-5	0	0	0	0		
3	3	-1	-2	2	-1	0	0	0	0		
4	0	-2	-3	3	-2	0	0	0	0		

		NDZ		NU		D (LONG.)		D LOG(R)			
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
1	-2	0	0	0	0	-1	1	0	0		
1	-1	-3	3	2	1	-3	3	0	0		
1	0	-1	-3	0	0	-1	-2	0	0		
1	1	0	0	0	0	0	-1	0	0		
2	-5	0	0	0	0	1	0	0	0		
2	-4	0	0	0	0	2	-1	0	0		
2	-3	1	0	0	-1	7	-4	0	-1		
2	-2	6	-3	-3	-6	27	-14	-2	-3		
2	-1	107	-53	-27	-54	107	-53	-5	-11		
2	0	-6	1	-3	-6	16	-10	1	1		
2	1	-1	0	0	0	4	-3	0	1		
2	2	0	0	0	0	1	-1	0	0		
3	-1	2	-1	-1	-1	2	-1	0	0		

Table A-1. (Cont.)
 Secular Terms
 g) Neptune on Mercury

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-256	0	-6772	0	-612	0
1	-26	235	235	-44	1953	-2215
2	78	2210	-2162	76	198	-226
3	24	671	-663	24	30	-34
4	7	182	-180	7	5	-6
5	2	48	-48	2	1	-1
6	0	13	-13	0	0	0
7	0	3	-3	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	1	0	-0	0	-0	0
1	-7	0	0	-3	1	-2

Table A-2. Venus
Periodic Terms
a) Mercury on Venus

		DX		DY		DZ		U/COS(1)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-6018	0	7992	0	-4157	0	-12	0	
0	1	53836	-1224	-1006	55055	0	0	0	0	
0	2	-5178	8002	-8007	-5357	229	-1173	1	-3	
0	3	-395	-805	822	-388	98	88	0	0	
0	4	137	7	-9	139	-18	6	0	0	
0	5	-11	18	-18	-11	0	-3	0	0	
0	6	-2	-3	3	-2	0	0	0	0	
1	-8	1	2	2	-1	0	0	0	0	
1	-7	-13	3	3	13	2	0	0	0	
1	-6	34	-81	-81	-33	-6	7	0	0	
1	-5	994	536	538	-1000	-21	-70	0	0	
1	-4	46517	-5587	-5559	-46493	1076	235	3	1	
1	-3	-206281	587215	588055	205437	3009	-2808	9	-8	
1	-2	-64946	54935	21443	-120249	229	9571	1	27	
1	-1	103834	-306635	306820	110539	1682	4840	5	14	
1	0	34281	42716	-43731	33898	2748	2417	8	7	
1	1	-445	-81	108	-475	233	-95	1	0	
1	2	30	-84	86	35	-4	35	0	0	
1	3	13	14	-14	14	-5	-3	0	0	
1	4	-3	1	-1	-3	0	0	0	0	
2	-10	0	0	0	-1	0	0	0	0	
2	-9	-1	7	6	3	0	0	0	0	
2	-8	-67	-55	-55	67	2	5	0	0	
2	-7	-1964	-3418	-3419	1964	-53	2	0	0	
2	-6	149760	-696894	-696912	-149731	-1147	1570	-3	4	
2	-5	-197251	-199798	-193524	215146	-231	-1031	-1	-3	
2	-4	-102974	597466	-611024	-158589	-10598	-3562	-30	-10	
2	-3	56300	78107	-49223	66092	1112	-597	3	-2	
2	-2	-2818	1160	-1819	-2350	-450	436	-1	1	
2	-1	35	-192	148	16	12	-492	0	-1	
2	0	3780	5217	-5257	3766	431	341	1	1	
2	1	3	-10	10	4	-5	4	0	0	
2	2	1	2	-2	1	0	-1	0	0	
2	10	-3	-3	-3	3	0	0	0	0	
3	-10	-53	59	53	52	5	0	0	0	
3	-9	-392	4325	4335	369	-25	49	0	0	
3	-8	-19271	-13408	-13336	19466	81	129	0	0	
3	-7	-7446	-3583	10608	8284	-651	-58	-2	0	
3	-6	9603	1378	-10906	8283	-333	396	-1	1	
3	-5	4801	2111	3321	-1683	-60	-299	0	-1	
3	-4	-2781	1231	505	2722	183	142	1	0	
3	-3	-207	443	510	114	-173	-54	0	0	
3	-2	-98	19	-45	-107	118	-78	0	0	
3	-1	-11	24	-23	-10	3	-7	0	0	
3	0	585	804	-809	585	58	48	0	0	
3	9	0	-1	-1	0	0	0	0	0	
3	10	32	20	20	-32	0	0	0	0	
4	-10	3951	-2406	-2709	-3881	16	0	0	0	
4	-9	-5392	-1442	3550	-5432	117	-229	0	-1	
4	-8	-1946	215	-1174	-284	38	70	0	0	
4	-7	948	-635	-394	-973	-74	-11	0	0	
4	-6	-33	1149	1104	123	58	-49	0	0	
4	-5	-567	-401	-413	549	-15	69	0	0	
4	-4	-259	106	55	257	-15	-62	0	0	
4	-3	-39	21	64	-22	40	15	0	0	
4	-2	-17	3	-5	-17	9	-5	0	0	
4	-1	0	4	-4	0	0	-2	0	0	
4	0	105	146	-147	105	11	9	0	0	
4	9	30	-31	-31	-30	0	0	0	0	
4	10	6824	3200	3201	-6824	-22	-25	0	0	

Table A-2. (Cont.)
a) Mercury on Venus

5	-10	-171	90	165	164	-12	1	0	0
5	-9	178	-200	-363	240	-9	16	0	0
5	-8	332	155	157	-314	-9	-21	0	0
5	-7	-303	194	190	306	24	9	0	0
5	-6	2	-168	-174	8	-25	6	0	0
5	-5	-113	-69	-84	91	17	-17	0	0
5	-4	-32	2	23	31	4	12	0	0
5	-3	-7	0	10	-5	6	3	0	0
5	-2	-3	0	-1	-2	1	0	0	0
5	0	21	29	-29	21	2	2	0	0
5	9	-2	10	11	1	0	0	0	0
5	10	-507	-191	-190	507	4	5	0	0
6	-10	97	-26	-122	-60	11	0	0	0
6	-9	-171	79	186	-219	5	-7	0	0
6	-8	-114	-45	-45	113	1	10	0	0
6	-7	29	-20	-28	-27	-7	-8	0	0
6	-6	-4	-57	-55	-7	9	2	0	0
6	-5	-17	-14	-11	20	-2	3	0	0
6	-4	-5	-2	6	4	0	3	0	0
6	-3	-2	0	1	-1	1	0	0	0
6	0	4	6	-6	4	0	0	0	0
6	8	0	-1	0	0	0	0	0	0
6	9	-3	-13	-13	3	0	0	0	0
6	10	509	145	144	-511	-4	-5	0	0
7	-10	-49	-16	93	24	-9	0	0	0
7	-9	161	-4	-76	182	-3	3	0	0
7	-8	5	2	-3	-4	1	-4	0	0
7	-7	18	-15	-11	-20	1	3	0	0
7	-6	0	-12	-13	0	0	0	0	0
7	-5	-3	-3	0	5	-1	1	0	0
7	0	1	1	-1	1	0	0	0	0
7	7	1	0	0	0	0	0	0	0
7	8	-1	2	2	2	0	0	0	0
7	9	0	14	14	-1	0	0	0	0
7	10	-469	-95	-92	471	3	5	0	0
8	-10	41	37	-57	24	5	2	0	0
8	-9	-103	-14	9	-104	2	0	0	0
8	-8	7	2	4	-9	0	0	0	0
8	-7	4	-4	-3	-7	0	0	0	0
8	-6	0	-3	-3	2	0	0	0	0
8	-5	0	-1	0	0	0	0	0	0
8	7	-2	0	0	2	0	0	0	0
8	8	2	-3	-3	-2	0	0	0	0
8	9	-7	-11	-11	9	0	0	0	0
8	10	284	36	33	-286	-2	-4	0	0
9	-10	1	-24	23	-3	-2	-2	0	0
9	-9	23	2	4	22	0	0	0	0
9	-8	2	0	3	-3	0	0	0	0
9	-7	2	-2	-2	0	0	0	0	0
9	-6	2	0	0	0	0	0	0	0
9	-5	0	2	-1	0	0	0	0	0
9	-4	-1	0	0	-1	0	0	0	0
9	7	2	0	0	-2	0	0	0	0
9	8	-1	3	2	2	0	0	0	0
9	9	-3	5	5	0	0	0	0	0
9	10	-63	0	3	65	0	3	0	0
10	-10	6	4	-2	7	0	0	0	0
10	-9	9	1	1	12	0	0	0	0
10	-8	3	-1	0	-2	0	0	0	0
10	-7	3	2	0	2	0	0	0	0
10	-6	-2	2	-2	-1	0	0	0	0
10	-5	0	-2	2	0	0	0	0	0
10	7	-2	0	0	1	0	0	0	0
10	8	0	-2	0	0	0	0	0	0
10	9	0	-1	0	3	0	0	0	0
10	10	-27	-5	-7	26	0	-1	0	0

Table A-2. (Cont.)
a) Mercury on Venus

J	K	NDZ ----- (IN UNITS OF 10**(-4))		NU SECONDS OF ARC		D (LONG.) -----		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	155	0	0	0	33	0
0	1	0	0	-31	46	0	0	-7	10
0	2	-1	1	-3	-5	-1	1	-1	-1
0	3	0	0	1	0	0	0	0	0
1	-4	3	-4	0	1	2	-6	0	0
1	-3	-78	-402	-129	26	-60	-396	-27	4
1	-2	2549	896	-280	802	2549	893	-59	169
1	-1	-18	17	172	244	0	23	36	53
1	0	2	7	-10	1	2	7	-2	0
1	1	-1	0	1	-2	-1	0	0	0
2	-6	14	34	17	-7	-12	29	3	1
2	-5	-3705	-806	55	-263	-3710	-800	12	-55
2	-4	-731	766	-411	-393	-757	760	-86	-85
2	-3	-24	-87	68	-19	-29	-81	14	-5
2	-2	42	14	-13	41	41	13	-3	9
2	-1	-16	11	10	14	-15	12	2	3
3	-8	33	2	0	-8	33	2	0	-2
3	-7	-56	81	-30	-21	-56	81	-6	-4
3	-6	12	27	-18	8	11	27	-4	2
3	-5	-15	-2	2	-12	-15	-2	0	-3
3	-4	8	-9	9	8	8	-9	2	2
3	-3	2	8	-8	3	2	7	-2	1
3	-2	1	0	-1	1	1	1	0	0
3	-1	-2	2	2	2	-2	2	0	0
4	-10	7	-15	-15	-7	7	-15	-3	-1
4	-9	-9	-14	8	-5	-9	-14	2	-1
4	-8	3	0	0	3	3	0	0	1
4	-7	-1	3	-2	-1	-1	3	0	0
4	-6	-2	-3	3	-1	-2	-3	1	0
4	-5	3	0	0	3	3	0	0	1
4	-4	-1	1	-2	-1	-1	2	0	0
4	-3	0	1	-1	0	0	1	0	0
4	11	9	-19	19	9	9	-19	4	2
5	-10	0	1	1	0	0	1	0	0
5	-9	0	0	0	0	0	1	0	0
5	-8	-1	0	0	-1	-1	0	0	0
5	-7	0	-1	1	0	0	-1	0	0
5	-6	1	1	-1	1	1	1	0	0
5	-5	0	0	0	-1	0	0	0	0
5	11	-1	1	-1	-1	-1	1	0	0
6	-10	0	-1	-1	0	0	-1	0	0
6	11	0	-1	1	0	0	-1	0	0
7	11	0	1	-1	0	0	1	0	0
8	11	0	-1	1	0	0	-1	0	0

Table A-2. (Cont.)
 Secular Terms
 a) Mercury on Venus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	2389270	0	1494695	0	-5758	0
1	8002	-1705	-1705	13454	560814	1208149
2	-796349	-498220	498208	-796330	1919	4135
3	-8176	-5115	5115	-8176	10	21
4	-75	-47	47	-75	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	-14	0	5	0	-6	0
1	2032	-3249	1624	1016	572	1232
2	3	-6	6	3	2	4

Table A-2. (Cont.)

Periodic Terms

b) Earth on Venus

		DX		DY		DZ		U/COS(1)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	-1473	0	7332	0	475	0	1	0		
0	1	-302376	12483	12683	-310581	0	0	0	0		
0	2	-5519	7394	-7204	-5840	2639	-537	8	-2		
0	3	-358	-1018	999	-387	117	-309	0	-1		
0	4	5	-14	13	4	-4	-12	0	0		
0	5	3	-2	2	3	-1	0	0	0		
1	-6	1	2	2	-1	0	0	0	0		
1	-5	0	4	3	0	-6	6	0	0		
1	-4	-694	32	9	706	-31	218	0	1		
1	-3	-51194	-26861	-26850	51409	1809	626	5	2		
1	-2	-5846015	-3265038	-3254408	5857364	264591	-31356	755	-89		
1	-1	203234	-54263	-42599	-183149	-4859	12444	-14	35		
1	0	9116194	5102456	-5056484	9125725	-180009	-385898	-513	-1100		
1	1	-50458	54878	-54331	-50788	6372	1050	18	3		
1	2	147	-2694	2692	100	393	-324	1	-1		
1	3	13	-35	34	12	4	-19	0	0		
1	4	4	0	0	4	-1	0	0	0		
2	-7	0	2	2	0	0	0	0	0		
2	-6	0	-3	-3	0	-5	2	0	0		
2	-5	-606	-826	-846	604	-93	118	0	0		
2	-4	-57920	-96188	-96237	58031	509	605	1	2		
2	-3	-6128317	-9895375	-9892884	6137627	85098	35079	243	100		
2	-2	18588	241731	272792	-50907	-27942	20478	-80	58		
2	-1	14683308	23823306	-23713718	14780147	22223	-310584	63	-886		
2	0	27981	-76466	77481	27878	19128	17835	55	51		
2	1	11797	-13804	13834	11740	833	-93	2	0		
2	2	144	-158	158	141	19	-22	0	0		
2	3	6	0	0	5	0	-2	0	0		
3	-8	0	2	2	0	0	0	0	0		
3	-7	3	10	10	-4	-4	0	0	0		
3	-6	32	549	537	-41	-96	39	0	0		
3	-5	3623	59253	59201	-3581	85	360	0	1		
3	-4	239335	5593968	5592159	-233328	26600	33159	76	95		
3	-3	-3791057	-3918781	-3977124	3782039	47112	-3178	134	-9		
3	-2	-809399	-19450490	19385374	-1019625	136488	-208654	389	-595		
3	-1	4612013	4728021	-4726063	4613268	-13922	-64159	-40	-183		
3	0	-15383	43447	-43372	-15428	1212	186	3	1		
3	1	-165	310	-309	-169	43	-17	0	0		
3	2	2	7	-7	2	0	-3	0	0		
4	-9	-1	1	1	1	0	0	0	0		
4	-8	0	7	7	-1	-2	-2	0	0		
4	-7	0	81	76	-9	-71	-9	0	0		
4	-6	-2543	6459	6427	2552	-35	177	0	1		
4	-5	-280257	558209	555326	283143	3653	21720	10	62		
4	-4	-213869	-789831	-799964	198794	10809	5107	31	15		
4	-3	1329323	-2706891	2688297	1347672	244083	-128324	696	-366		
4	-2	395057	1498232	-1495925	398997	6964	-23498	20	-67		
4	-1	686	11576	-11452	684	1895	2092	5	6		
4	0	309	-39	43	305	72	12	0	0		
4	1	5	5	-5	5	3	-3	0	0		
5	-10	-1	0	0	1	0	0	0	0		
5	-9	-2	6	7	2	0	-2	0	0		
5	-8	5	48	49	-12	-40	-30	0	0		
5	-7	-1195	1182	1168	1194	-50	75	0	0		
5	-6	-127613	77436	74840	128356	-4072	11502	-12	33		
5	-5	355310	-1434012	-1433347	-365750	6343	4843	18	14		
5	-4	-954865	-2588568	-1415784	2650849	1051657	24580	2999	70		
5	-3	-1050803	3968559	-3967202	-1022870	5313	-13511	15	-39		
5	-2	1618728	1822453	-1822267	1618777	3638	19759	10	56		
5	-1	15678	12938	-12931	15676	101	129	0	0		
5	0	133	106	-106	133	5	-1	0	0		
5	1	1	2	-2	1	0	0	0	0		

Table A-2. (Cont.)

b) Earth on Venus

6	-11	-2	0	0	2	0	0	0	0
6	-10	-4	5	5	5	0	-1	0	0
6	-9	-8	45	49	3	-15	-32	0	0
6	-8	-511	307	303	513	-37	28	0	0
6	-7	-53679	7009	5255	53265	-5307	4662	-15	13
6	-6	-104246	101098	105128	98868	-514	2832	-1	8
6	-5	385237	-291527	-208726	499547	-143944	-84481	-410	-241
6	-4	401318	-414342	414787	398972	22428	-2543	64	-7
6	-3	84530	363493	-363337	84826	1981	-5429	6	-15
6	-2	-562	1710	-1699	-559	94	159	0	0
6	-1	0	12	-12	0	7	2	0	0
6	0	0	1	-1	0	0	0	0	0
7	-12	-1	0	0	1	0	0	0	0
7	-11	-7	3	3	7	0	0	0	0
7	-10	-73	38	41	23	2	-25	0	0
7	-9	-203	104	103	209	-23	9	0	0
7	-8	-18927	-7402	-8290	18108	-4117	891	-12	3
7	-7	-29520	5876	10052	27875	-1049	1500	-3	4
7	-6	227749	-5618	-180422	170114	-24741	-42030	-71	-120
7	-5	149254	-60690	33694	163374	31409	11779	90	34
7	-4	-63985	205372	-205385	-63206	2259	-2027	6	-6
7	-3	3972	9361	-9350	3983	-24	513	0	1
7	-2	95	80	-79	95	8	9	0	0
7	-1	0	2	-2	0	0	0	0	0
8	-13	0	-1	-1	0	0	0	0	0
8	-12	-8	0	-1	8	0	0	0	0
8	-11	-37	24	27	39	10	-15	0	0
8	-10	-110	86	81	119	-15	1	0	0
8	-9	-5430	-6324	-6569	4661	-7460	-746	-7	-2
8	-8	-10365	-2738	298	10855	-1053	528	-3	2
8	-7	-22780	172310	-9953	161138	-767	-21147	-2	-60
8	-6	70543	-352022	-383037	66255	-59896	-69214	-171	-197
8	-5	298552	-270748	271782	296379	3282	476	9	1
8	-4	-1060	405935	-405926	-1033	1293	-1985	4	-6
8	-3	-447	2423	-2422	-446	10	10	0	0
8	-2	-5	18	-18	-5	0	0	0	0
9	-14	0	-2	-2	0	0	0	0	0
9	-13	-7	-5	-5	7	0	0	0	0
9	-12	-46	5	6	48	12	-6	0	0
9	-11	-114	85	74	122	-9	-2	0	0
9	-10	-808	-3464	-3350	287	-1110	-1149	-3	-3
9	-9	-2343	-3383	-1710	3711	-770	-30	-2	0
9	-8	481	64344	-61032	17426	4772	-9229	14	-26
9	-7	34725	9846	-37822	18795	-2295	-10829	-7	-31
9	-6	39346	-8778	8040	39462	2802	1418	8	4
9	-5	-13712	24246	-24256	-13667	420	-222	1	-1
9	-4	-80	240	-239	-79	-5	33	0	0
9	-3	0	3	-2	0	0	0	0	0
10	-15	0	-2	-2	0	0	0	0	0
10	-14	-4	-9	-9	4	0	0	0	0
10	-13	-47	-18	-19	48	10	0	0	0
10	-12	-153	54	38	157	-5	-4	0	0
10	-11	337	-1443	-1208	-588	-260	-974	-1	-3
10	-10	120	-1915	-1350	1340	-435	-265	-1	-1
10	-9	-14935	33107	-34688	-11005	4635	-3082	13	-9
10	-8	18571	11700	-26032	-5434	1289	-4153	4	-12
10	-7	15326	-5237	-14124	11932	4311	6314	12	18
10	-6	-31041	18341	-18440	-30925	296	-30	1	0
10	-5	-1518	7901	-7900	-1516	-90	103	0	0
10	-4	1	70	-70	1	0	2	0	0
11	-16	2	-1	-1	-2	0	0	0	0
11	-15	0	-11	-11	-1	0	0	0	0
11	-14	-37	-42	-44	36	7	4	0	0
11	-13	-188	-16	-33	184	0	-5	0	0
11	-12	291	-416	-213	-343	159	-626	0	-2
11	-11	709	-748	-915	464	-166	-296	0	-1
11	-10	-16831	13136	-14272	-15817	3130	-253	9	-1
11	-9	-5382	11614	-11591	1329	1565	-1525	4	-4
11	-8	8152	394	-9669	797	-300	-3563	-1	-10
11	-7	12669	-167	181	12645	265	230	1	1
11	-6	-4866	6181	-6182	-4863	99	-34	0	0
11	-5	-36	25	-25	-36	0	2	0	0
12	-17	2	0	0	-2	0	0	0	0
12	-16	7	-11	-11	-7	0	0	0	0
12	-15	-14	-61	-62	12	3	5	0	0
12	-14	-188	-116	-132	175	3	-3	0	0
12	-13	-36	-81	25	81	289	-306	1	-1
12	-12	645	-67	-637	115	0	-227	0	-1
12	-11	-12509	2149	-2697	-12430	1674	759	5	2
12	-10	-5025	5329	-5890	-4057	1168	-315	3	-1
12	-9	2056	3017	-4083	-585	415	-896	1	-3
12	-8	2680	1317	-1598	2565	176	425	1	1
12	-7	-2686	1080	-1085	-2681	46	8	0	0
12	-6	-45	79	-79	-45	-5	4	0	0
13	-18	2	0	1	-3	0	0	0	0
13	-17	13	-8	-5	-14	0	0	0	0
13	-16	20	-70	-69	-23	0	5	0	0

Table A-2. (Cont.)

b) Earth on Venus

13	-15	-131	-225	-234	109	5	0	0	0
13	-14	-297	-156	-146	347	266	-83	1	0
13	-13	402	263	-480	-61	75	-131	0	0
13	-12	-7185	-2431	2254	-7270	661	889	2	3
13	-11	-4765	1295	-2110	-3675	690	171	2	0
13	-10	-38829	-28809	-32804	37512	386	-429	1	-1
13	-9	3654241	-3166615	-3168665	-3653337	5480	-48331	16	-138
13	-8	190288	27731	-26930	190030	-39	526	0	1
13	-7	-3665521	3178772	-3178736	-3665477	1031	-156	3	0
13	-6	-25090	21585	-21584	-25089	3	0	0	0
13	-5	-193	166	-166	-193	0	0	0	0
13	-4	-2	1	-1	-2	0	0	0	0
13	18	1	4	4	-1	0	0	0	0
14	-18	17	0	2	-17	-3	2	0	0
14	-17	55	-65	-51	-66	-2	4	0	0
14	-16	-8	-309	-306	-18	5	5	0	0
14	-15	-357	-436	-482	355	186	39	1	0
14	-14	144	387	-374	-193	86	-50	0	0
14	-13	-3041	-3263	3262	-3093	91	680	0	2
14	-12	-2917	-425	293	-2910	318	297	1	1
14	-11	-1080	746	-958	-823	243	-27	1	0
14	-10	312	581	-705	-283	140	-193	0	-1
14	-9	584	456	-463	578	9	43	0	0
14	-8	-473	101	-101	-473	8	3	0	0
14	-7	-4	0	0	-4	0	0	0	0
14	18	15	18	18	-15	0	0	0	0
15	-18	90	-26	-24	-98	-20	19	0	0
15	-17	135	-354	-287	-231	2	9	0	0
15	-16	-165	-762	-803	90	101	89	0	0
15	-15	-90	389	-262	-317	64	0	0	0
15	-14	-651	-2400	2442	-624	-160	406	0	1
15	-13	-1553	-1160	1108	-1578	83	260	0	1
15	-12	-790	129	-197	-769	133	57	0	0
15	-11	-14	376	-272	-335	81	-37	0	0
15	-10	144	194	-257	34	-23	79	0	0
15	-9	-384	-124	123	-384	3	3	0	0
15	-8	-41	22	-22	-41	-1	0	0	0
15	-7	2	0	0	-2	0	0	0	0
15	18	123	86	86	-123	-4	0	0	0
16	-18	361	-282	-179	-398	-22	62	0	0
16	-17	93	-1017	-916	-594	33	96	0	0
16	-16	-297	300	-106	-426	32	21	0	0
16	-15	217	-1159	1172	302	-223	183	-1	1
16	-14	-546	-1184	1166	-568	-34	171	0	0
16	-13	-474	-170	148	-479	55	71	0	0
16	-12	-247	56	-183	-134	45	4	0	0
16	-11	163	103	-117	-198	62	-62	0	0
16	-10	202	222	-221	201	0	5	0	0
16	-9	-219	9	-9	-219	2	1	0	0
16	-8	-1	0	0	-1	0	0	0	0
16	-7	10	19	19	-10	0	0	0	0
16	18	672	152	152	-672	-28	7	0	0
17	-18	931	-742	-989	-1021	-82	428	0	1
17	-17	-1464	136	98	-1488	7	21	0	0
17	-16	66	-261	212	169	-196	35	-1	0
17	-15	56	-897	892	40	-73	86	0	0
17	-14	-203	-240	238	-208	8	58	0	0
17	-13	-146	-3	-17	-142	21	15	0	0
17	-12	-17	57	-36	-59	19	-5	0	0
17	-11	13	52	-53	10	-3	5	0	0
17	-10	-39	-20	20	-39	0	0	0	0
17	-7	33	-41	-41	-33	0	0	0	0
17	18	3568	-50	-50	-3568	-64	50	0	0
18	-18	-1721	-881	1120	-1614	-25	32	0	0
18	-17	-2041	239	-356	-1964	-139	-49	0	0
18	-16	320	-543	544	308	-69	25	0	0
18	-15	-29	-188	190	-29	-14	37	0	0
18	-14	-84	-45	40	-86	7	14	0	0
18	-13	-11	46	21	-55	8	2	0	0
18	-12	77	33	-8	-90	-23	15	0	0
18	-11	-60	-94	93	-60	0	0	0	0
18	-10	-76	-12	12	-76	0	0	0	0
18	-7	7	5	5	-7	0	0	0	0
18	-6	606	334	334	-606	-3	1	0	0
18	18	6168	-1114	-1123	-6165	-271	314	-1	1

Table A-2. (Cont.)

b) Earth on Venus

		NDZ (IN UNITS OF 10**(-4))				D (LONG.) (IN UNITS OF 10**(-9))		D LOG(R) (IN UNITS OF 10**(-9))	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-871	0	0	0	-183	0
0	1	0	0	-27	42	0	0	-6	9
0	2	39	-13	11	33	39	-13	2	7
0	3	0	0	1	0	1	-1	0	0
1	-3	16	17	16	-14	14	20	4	-3
1	-2	-14	92	60	6	-177	385	43	18
1	-1	-23780	42701	9320	5190	-23781	42696	1962	1093
1	0	-178	-906	293	-46	-340	-613	31	-27
1	1	14	14	-11	56	72	10	-2	12
1	2	1	0	0	1	2	0	0	0
2	-4	3	14	14	-3	-4	18	3	0
2	-3	-172	83	76	145	-829	491	59	100
2	-2	-96000	59500	24519	39560	-95991	59498	5162	8328
2	-1	1551	-392	60	321	895	16	-30	-2
2	0	195	171	-105	120	200	172	-22	26
2	1	2	0	0	2	3	2	0	1
3	-5	-2	8	8	2	3	8	2	0
3	-4	111	-25	-20	-126	598	-46	-6	-78
3	-3	71393	-3348	-1844	-39331	71221	-3184	-371	-8263
3	-2	-25251	23978	2360	2332	-24763	23953	499	543
3	-1	-116	-442	182	-45	-285	-278	21	-27
3	0	3	1	-1	2	0	-1	0	0
4	-6	-4	4	4	4	-3	4	1	1
4	-5	14	-9	-3	-20	77	22	3	-11
4	-4	9290	4619	3022	-6076	9244	4630	637	-1275
4	-3	-6609	1684	538	2013	-6546	1716	110	431
4	-2	-23	18	-28	-9	-68	30	-7	-7
4	-1	4	7	-5	3	3	7	-1	1
5	-7	-4	1	1	4	-3	1	0	1
5	-6	8	-7	-2	-8	20	12	2	-3
5	-5	1891	2782	2031	-1376	1785	2755	425	-279
5	-4	-15378	-4045	-1899	7263	-15439	-3959	-395	1538
5	-3	-10804	9786	-518	-540	-10909	9756	-106	-125
5	-2	-1	55	-30	-1	-76	121	-13	-8
5	-1	0	0	0	0	0	1	0	0
6	-8	-2	-1	-1	3	-2	-1	0	1
6	-7	7	-3	0	-6	8	6	1	-1
6	-6	137	1415	1117	-109	147	1425	236	-24
6	-5	1479	1417	852	-881	1468	1430	179	-184
6	-4	-1761	394	76	325	-1751	403	15	69
6	-3	4	-7	1	1	-8	-4	0	-1
7	-9	-1	-1	-1	1	-1	-1	0	0
7	-8	6	0	1	-4	4	4	1	-1
7	-7	-271	621	518	226	-270	624	109	47
7	-6	161	922	363	-108	153	525	76	-22
7	-5	-852	-268	-100	320	-851	-264	-21	68
7	-4	-60	33	-8	-14	-66	31	-2	-3
7	-3	0	1	-1	0	-1	2	0	0
8	-10	0	-1	-1	0	0	-1	0	0
8	-9	4	2	-2	2	2	3	1	0
8	-8	-278	212	184	242	-279	214	39	51
8	-7	-45	223	170	35	-40	232	36	7
8	-6	1012	1109	586	-534	997	1110	123	-111
8	-5	-2213	-17	111	111	-2206	-9	-1	24
8	-4	3	-4	2	1	-12	-4	0	-1
9	-11	0	-1	-1	0	0	-1	0	0
9	-10	2	2	2	-1	1	3	0	0
9	-9	-189	27	24	170	-189	28	5	36
9	-8	-73	85	68	60	-74	86	14	13
9	-7	30	136	88	-19	28	136	18	-4
9	-6	-109	-63	-16	29	-109	-62	-4	6
9	-5	-1	0	0	-1	-2	0	0	0
10	-11	1	2	-1	0	0	2	0	0
10	-10	-101	-38	-36	93	-101	-38	-7	20
10	-9	-57	21	17	49	-58	21	4	10
10	-8	-14	44	33	11	-15	44	7	2
10	-7	-73	-123	-54	32	-73	-123	-11	7
10	-6	-50	-8	1	-5	-50	-9	0	-1
10	-5	0	0	0	-1	-1	0	0	0
11	-12	0	2	1	0	-1	2	0	0
11	-11	-40	-47	-46	38	-40	-48	-10	8
11	-10	-35	-6	-5	31	-35	-6	-1	6
11	-9	-16	14	12	13	-16	15	2	3
11	-8	1	46	26	0	0	45	0	0
11	-7	-31	-25	-3	-4	-31	-24	-1	1
11	-6	0	0	0	1	0	0	0	0
12	-13	-1	1	0	1	-1	1	0	0
12	-12	-7	-35	-36	7	-7	-36	-8	1
12	-11	-17	-13	-12	15	-17	-14	-3	3
12	-10	-11	2	2	9	-11	2	0	2
12	-9	-5	9	6	3	-5	9	1	1
12	-8	-5	-11	-4	2	-5	-11	-1	0
12	-7	-1	0	0	0	-1	0	0	0
13	-14	-2	1	0	0	-2	1	0	0
13	-13	6	-20	-22	-7	6	-20	-5	-1
13	-12	-5	-12	-11	5	-5	-13	-2	1

Table A-2. (Cont.)

b) Earth on Venus

13	-11	-6	-2	-2	5	-6	-2	0	1
13	-10	-4	3	3	3	-5	7	1	1
13	-9	-104	722	362	52	-228	579	61	24
13	-8	-18097	-20877	-35	32	-18098	-20872	-8	7
13	-7	2	0	0	1	-122	-143	15	-13
13	-6	0	0	0	0	-1	-1	0	0
14	-15	-2	0	0	0	-2	0	0	0
14	-14	8	-8	-10	-11	8	-8	-2	-2
14	-13	1	-9	-8	-1	1	-9	-2	0
14	-12	-2	-3	-3	2	-2	-3	-1	1
14	-11	-2	0	0	2	-2	0	0	0
14	-10	-2	2	1	1	-2	2	0	0
14	-9	0	-2	0	0	0	-2	0	0
15	-16	-2	-1	0	0	-2	-1	0	0
15	-15	5	-1	-2	-9	5	-2	0	-2
15	-14	3	-5	-4	-3	3	-5	-1	-1
15	-13	0	-2	-2	1	0	-2	0	0
15	-12	-1	-1	0	1	-1	-1	0	0
15	-11	-1	0	0	1	-1	0	0	0
15	-10	0	-1	0	0	0	-1	0	0
16	-18	0	-1	-1	0	0	-1	0	0
16	-17	-1	-2	0	0	-1	-2	0	0
16	-16	1	0	2	-6	1	0	0	-1
16	-15	4	-2	-1	-3	4	-2	0	-1
16	-14	0	-1	-1	0	0	-1	0	0
16	-13	0	-1	-1	0	0	-1	0	0
16	-11	-1	1	0	0	-1	1	0	0
16	-10	0	-1	0	0	0	-1	0	0
16	19	0	-2	2	0	0	-2	0	0
17	-18	0	-4	-4	0	0	-4	-1	0
17	-17	-2	-2	3	-3	-2	-2	1	-1
17	-16	3	0	0	-2	3	0	0	0
17	-15	1	0	-1	-1	1	0	0	0
17	19	0	-10	10	0	0	-10	2	0
18	-19	3	-5	-5	-3	3	-5	-1	-1
18	-18	-1	-6	-6	1	-1	-6	-1	0
18	-17	2	1	1	-1	2	1	0	0
18	-16	0	0	0	-1	0	0	0	0
18	18	1	-2	2	1	1	-2	0	0
18	19	-3	-18	18	-3	-3	-18	4	-1

Secular Terms

b) Earth on Venus

J	DX		DY		DZ	
	COS	SIN	COS	SIN	COS	SIN
0	6996624	0	5498362	0	-247917	0
1	27761	-6272	-6272	43724	24146881	-33386830
2	-2331989	-1832744	1832702	-2331935	82636	-114258
3	-23942	-18816	18816	-23942	424	-587
4	-219	-172	172	-218	3	-4
5	-2	-2	2	-2	0	0
J	NDZ		NU		U/COS(I)	
	COS	SIN	COS	SIN	COS	SIN
0	-51	0	20	0	-253	0
1	7476	-9514	4757	3738	24625	-34048
2	13	-16	16	13	84	-117
3	0	0	0	0	0	-1

(THE TERMS ARE IN UNITS OF 10**(-6) SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

Table A-2. (Cont.)
Periodic Terms
c) Mars on Venus

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))-----								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	792	0	276	0	167	0	0	0		
0	1	-5699	-19	-12	-5567	0	0	0	0		
0	2	717	275	-276	714	-7	-62	0	0		
0	3	10	2	-1	10	0	1	0	0		
1	-4	0	2	2	0	0	0	0	0		
1	-3	190	101	102	-192	-3	-8	0	0		
1	-2	49946	-21930	-21912	-49913	-60	679	0	2		
1	-1	25066	-1898	1025	-22437	-422	644	-1	2		
1	0	-104828	46717	-46309	-106511	1272	918	4	3		
1	1	-17618	551	-552	-17602	286	486	1	1		
1	2	-326	-42	42	-327	0	-6	0	0		
1	3	-3	0	1	-3	0	0	0	0		
2	-5	4	-6	-6	-5	0	0	0	0		
2	-4	374	-483	-483	-373	0	0	0	0		
2	-3	29075	-31779	-31801	-29083	-48	-137	0	0		
2	-2	34141	-17408	-18978	-34550	0	491	0	1		
2	-1	-112783	127543	-128176	-119952	-2285	-480	-7	-1		
2	0	-52128	28019	-28012	-52223	714	489	2	1		
2	1	-2117	321	-320	-2116	27	41	0	0		
2	2	-25	2	-2	-25	0	0	0	0		
3	-7	0	0	0	-1	0	0	0	0		
3	-5	26	31	32	-28	0	0	0	0		
3	-4	3109	-1837	-1821	-3112	28	31	0	0		
3	-3	389573	-435732	-434923	-389630	-152	-59	0	0		
3	-2	1760593	-1131042	-1092828	-1746213	-29798	7853	-65	22		
3	-1	-1145098	1303591	-1306175	-1158556	-499	-264	-1	-1		
3	0	-1802578	1145768	-1145753	-1802551	2800	1797	8	5		
3	1	-14483	8183	-8183	-14482	12	10	0	0		
3	2	-117	64	-64	-117	0	0	0	0		
3	3	-1	0	0	0	0	0	0	0		
3	10	0	-1	-1	0	0	0	0	0		
4	-10	0	0	1	0	0	0	0	0		
4	-9	0	0	-2	0	0	0	0	0		
4	-8	-1	0	1	2	0	0	0	0		
4	-7	0	0	-1	-2	0	0	0	0		
4	-6	-5	-16	-15	7	0	0	0	0		
4	-5	-49	-345	-353	54	-12	-5	0	0		
4	-4	-1065	3507	3203	1226	28	18	0	0		
4	-3	-13800	20681	12740	14548	250	-228	1	-1		
4	-2	6001	-17415	16320	4661	1142	-256	3	-1		
4	-1	31601	-37329	37359	31693	-244	-43	-1	0		
4	0	-224	137	-138	-225	-33	-19	0	0		
4	1	7	-1	2	7	0	0	0	0		
4	10	0	-4	-4	0	0	0	0	0		
5	-10	-1	0	3	0	0	0	0	0		
5	-9	2	2	-6	-1	0	0	0	0		
5	-8	-1	0	2	2	0	0	0	0		
5	-7	3	4	2	-5	0	0	0	0		
5	-6	33	55	59	-36	5	0	0	0		
5	-5	-121	-470	-379	6	-12	-2	0	0		
5	-4	-1590	2563	4416	548	-20	66	0	0		
5	-3	-5670	11414	3650	6508	380	-297	1	-1		
5	-2	4158	-14039	14060	4196	228	-50	1	0		
5	-1	9569	-11872	11874	9574	-85	-13	0	0		
5	0	72	-79	78	72	-3	-2	0	0		
5	10	0	-10	-10	0	0	0	0	0		

Table A-2. (Cont.)

c) Mars on Venus

6	-10	-3	0	7	0	0	0	0	0
6	-9	3	7	-11	-1	0	0	0	0
6	-8	-2	-2	3	4	0	0	0	0
6	-7	-12	-6	-10	12	-1	0	0	0
6	-6	78	87	72	-16	5	-1	0	0
6	-5	153	12	-363	352	-4	-19	0	0
6	-4	-5952	17117	19155	4771	-30	69	0	0
6	-3	-87359	116545	111544	87941	1749	-1338	5	-4
6	-2	14676	-53739	53851	14786	38	0	0	0
6	-1	92177	-120085	120084	92176	-146	-19	0	0
6	0	636	-822	822	636	0	0	0	0
6	1	5	-6	6	5	0	0	0	0
6	9	0	1	1	0	0	0	0	0
6	10	-2	-23	-23	2	0	0	0	0
7	-10	-6	-4	14	-3	0	0	0	0
7	-9	3	15	-19	0	0	0	0	0
7	-8	4	-3	4	-3	0	0	0	0
7	-7	-33	-9	-16	4	-2	1	0	0
7	-6	-58	39	82	-133	5	5	0	0
7	-5	293	-33	-509	363	0	-24	0	0
7	-4	-76	-1941	-634	-709	-30	57	0	0
7	-3	-51	1725	-1038	459	-85	66	0	0
7	-2	-723	2936	-2939	-725	15	-5	0	0
7	-1	166	-213	213	166	3	0	0	0
7	0	1	-2	2	1	0	0	0	0
7	9	2	3	3	-2	0	0	0	0
7	10	-3	-44	-44	3	0	0	0	0
8	-10	-12	-15	24	-8	0	0	0	0
8	-9	3	25	-25	4	0	0	0	0
8	-8	12	-6	7	0	0	0	0	0
8	-7	15	-17	-4	46	-2	0	0	0
8	-6	-121	7	68	-170	4	7	0	0
8	-5	195	-61	-387	268	0	-18	0	0
8	-4	-96	-862	-190	-325	-23	44	0	0
8	-3	143	928	-896	168	-13	10	0	0
8	-2	-184	848	-848	-184	5	-2	0	0
8	-1	4	-2	2	4	0	0	0	0
8	9	4	7	7	-4	0	0	0	0
8	10	-8	-64	-64	8	0	0	0	0
9	-10	-19	-24	26	-18	0	0	0	0
9	-9	-3	32	-30	1	0	0	0	0
9	-8	-3	6	-4	-13	0	0	0	0
9	-7	46	-19	6	66	-3	-2	0	0
9	-6	-98	-7	38	-125	3	6	0	0
9	-5	-8	-644	-814	258	0	-10	0	0
9	-4	646	-4108	-3787	-853	-55	107	0	0
9	-3	431	2215	-2206	441	-2	1	0	0
9	-2	-806	4262	-4262	-806	6	-2	0	0
9	-1	-4	27	-27	-4	0	0	0	0
9	7	1	0	0	-1	0	0	0	0
9	8	-1	-1	-1	1	0	0	0	0
9	9	7	9	9	-7	0	0	0	0
9	10	0	-75	-75	0	0	0	0	0
10	-10	-15	-58	54	-17	0	0	0	0
10	-9	3	0	0	6	0	0	0	0
10	-8	-15	15	-14	-22	1	0	0	0
10	-7	41	-14	7	52	-2	-2	0	0
10	-6	-54	3	26	-74	1	4	0	0
10	-5	76	116	40	41	0	-6	0	0
10	-4	-47	-108	44	-58	4	-7	0	0
10	-3	-41	-182	182	-42	0	0	0	0
10	-2	-4	21	-21	-4	0	0	0	0
10	6	-2	0	0	2	0	0	0	0
10	7	3	0	0	-3	0	0	0	0
10	8	-3	-2	-2	2	0	0	0	0
10	9	6	20	20	-6	0	0	0	0
10	10	-9	-7	-7	9	0	0	0	0

Table A-2. (Cont.)

c) Mars on Venus

J	K	NDZ ----- (IN UNITS OF 10**(-4))		NU SECONDS OF ARC		D (LONG.) -----		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-16	0	0	0	-3	0
0	1	0	0	4	2	0	0	1	0
1	-2	5	4	2	-3	3	1	0	0
1	-1	-195	-443	-159	70	-195	-444	-34	15
1	0	-2	-115	18	0	-3	-118	4	0
1	1	1	-3	2	0	1	-4	0	0
2	-3	-4	-2	-2	3	-7	-5	-1	1
2	-2	-455	-414	-250	274	-456	-416	-53	58
2	-1	-128	-244	-50	27	-131	-246	-10	5
2	0	-1	-15	5	0	-2	-17	1	0
3	-4	1	0	0	-1	1	0	0	0
3	-3	49	12	7	-34	15	-19	-2	-4
3	-2	-4942	-4362	-2209	2502	-4985	-4431	-472	531
3	-1	-6404	-10110	-133	88	-6438	-10140	-25	15
3	0	-4	-25	12	-2	-48	-94	10	-5
3	1	0	0	0	0	0	-1	0	0
4	-5	-1	0	0	0	-1	0	0	0
4	-4	-12	1	1	10	-12	1	0	2
4	-3	58	18	13	-39	59	19	3	-8
4	-2	154	131	50	-59	154	131	10	-12
4	-1	-3	-3	1	-1	-2	-2	0	0
5	-5	3	-2	-1	-2	3	-2	0	0
5	-4	-12	1	1	10	-12	1	0	2
5	-3	50	15	9	-30	50	15	2	-6
5	-2	55	45	10	-12	55	45	2	-3
6	-6	-1	1	1	0	-1	1	0	0
6	-5	3	-2	-2	-3	3	-2	0	-1
6	-4	-8	1	1	6	-6	2	0	1
6	-3	203	56	29	-104	208	59	6	-22
6	-2	666	512	13	-17	668	513	3	-3
6	-1	0	0	0	0	5	4	0	0
7	-6	-1	1	1	1	-1	1	0	0
7	-5	2	-1	-1	-2	2	-1	0	0
7	-4	-5	1	0	3	-5	1	0	1
7	-3	-12	-3	-1	5	-12	-3	0	1
7	-2	2	1	0	0	2	1	0	0
8	-6	0	1	1	0	0	1	0	0
8	-5	1	-1	-1	-1	1	-1	0	0
8	-4	-3	1	0	2	-3	1	0	0
8	-3	-4	-1	0	1	-4	-1	0	0
9	-5	1	0	0	0	0	0	0	0
9	-4	-8	2	1	4	-8	2	0	1
9	-3	-23	-4	0	1	-23	-4	0	0
10	-4	1	0	0	0	1	0	0	0

Table A-2. (Cont.)

Secular Terms

c) Mars on Venus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	280020	0	-727738	0	-2646	0
1	973	830	830	1612	257751	-142306
2	-93331	242574	-242568	-93329	882	-487
3	-958	2490	-2490	-958	5	-2
4	-9	23	-23	-9	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	7	0	1	0	-3	0
1	-990	-381	190	-495	263	-145
2	-2	-1	1	-2	1	0

Table A-2. (Cont.)

Periodic Terms

d) Jupiter on Venus

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	10425	0	4297	0	2007	0	6	0	
0	1	-315417	1130	1248	-317973	0	0	0	0	
0	2	6090	4289	-4301	6086	-158	-381	0	-1	
0	3	-168	-167	167	-168	-2	-2	0	0	
0	4	-3	-2	2	-3	0	0	0	0	
1	-5	2	-1	-1	-2	0	0	0	0	
1	-4	189	-127	-127	-189	0	0	0	0	
1	-3	18303	-16393	-16393	-18304	-13	21	0	0	
1	-2	1287066	-2390328	-2390523	-1287044	-941	7085	-3	20	
1	-1	2771133	-122359	-14027	-2829179	-86058	13244	-245	38	
1	0	-3586734	6608874	-6761110	-3615524	18453	-15575	53	-44	
1	1	-2675182	96375	-96272	-2675302	76280	27744	218	79	
1	2	-23214	-6884	6883	-23214	255	71	1	0	
1	3	-206	-86	86	-206	1	0	0	0	
1	4	-2	0	0	-2	0	0	0	0	
2	-5	-45	-50	-50	45	0	0	0	0	
2	-4	-3997	-4898	-4898	3997	-2	-1	0	0	
2	-3	-256828	-372265	-372231	256834	-363	-219	-1	-1	
2	-2	-61567	-448058	-447549	73909	39	3122	0	9	
2	-1	1624708	2201934	-2167094	1419348	120687	561872	344	1602	
2	0	197145	1224184	-1222035	197305	1141	-9250	3	-76	
2	1	-91652	-9973	9981	-91663	2720	1032	8	3	
2	2	-630	-397	397	-631	9	2	0	0	
2	3	-6	-5	5	-6	0	0	0	0	
3	-6	3	-1	-1	-3	0	0	0	0	
3	-5	215	-75	-75	-215	0	0	0	0	
3	-4	11720	-2524	-2532	-11720	31	-18	0	0	
3	-3	-52244	-70758	-72087	51117	-35	-65	0	0	
3	-2	-139821	-31006	-63642	-114634	7851	2496	22	7	
3	-1	300641	410052	-405364	290853	15421	65961	44	188	
3	0	34553	123967	-123844	34613	88	-1129	0	-3	
3	1	-4027	-1419	1420	-4028	125	53	0	0	
3	2	-21	-28	28	-21	0	0	0	0	
4	-6	-1	14	14	1	0	0	0	0	
4	-5	-153	547	548	152	0	3	0	0	
4	-4	3149	-715	-502	-3220	9	0	0	0	
4	-3	-4060	-18397	-775	10422	-315	330	-1	1	
4	-2	-34112	456	-9165	-31479	2097	565	6	2	
4	-1	40250	53242	-52782	39731	1505	6048	4	17	
4	0	3488	10928	-10921	3493	8	-110	0	0	
4	1	-195	-134	135	-195	6	3	0	0	
4	2	0	-2	2	0	0	0	0	0	
5	-6	-25	-23	-23	26	0	0	0	0	
5	-5	-43	191	186	71	0	0	0	0	
5	-4	1096	488	-701	19	-11	-35	0	0	
5	-3	147	-4048	1838	1885	-102	114	0	0	
5	-2	-5475	508	-1264	-5242	357	87	1	0	
5	-1	4641	5932	-5891	4612	132	505	0	1	
5	0	301	909	-908	301	0	-10	0	0	
5	1	-10	-11	11	-10	0	0	0	0	
6	-7	2	0	0	-2	0	0	0	0	
6	-6	-12	-9	-12	9	0	0	0	0	
6	-5	-86	61	17	-63	3	0	0	0	
6	-4	304	226	-257	157	-5	-14	0	0	
6	-3	97	-707	472	288	-20	23	0	0	
6	-2	-718	98	-162	-699	49	11	0	0	
6	-1	492	608	-605	490	11	40	0	0	
6	0	24	73	-73	24	0	0	0	0	
7	-7	1	0	0	-1	0	0	0	0	
7	-6	-1	-10	5	4	0	0	0	0	
7	-5	-38	17	-5	-35	2	0	0	0	
7	-4	64	54	-58	46	-1	-3	0	0	
7	-3	18	-104	80	38	-3	4	0	0	
7	-2	-83	14	-19	-82	6	1	0	0	
7	-1	49	59	-59	49	0	3	0	0	
7	0	2	6	-6	2	0	0	0	0	
8	-6	0	-5	4	1	0	0	0	0	
8	-5	-10	4	-2	-10	0	0	0	0	
8	-4	11	10	-10	9	0	0	0	0	
8	-3	3	-14	11	5	0	0	0	0	
8	-2	-9	2	-2	-9	0	0	0	0	
8	-1	5	6	-6	5	0	0	0	0	
9	-6	0	-1	1	0	0	0	0	0	
9	-5	-2	0	0	-2	0	0	0	0	
9	-4	2	1	-1	1	0	0	0	0	
9	-3	0	-2	1	0	0	0	0	0	

Table A-2. (Cont.)
d) Jupiter on Venus

J	K	NDZ (IN UNITS OF 10**(-4))		NU SECONDS OF ARC		D (LONG.)		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-903	0	0	0	-190	0
0	1	0	0	41	25	0	0	9	5
0	2	4	-4	3	3	4	-4	1	1
1	-3	0	0	-1	0	-1	-2	0	0
1	-2	112	-133	-101	-69	-68	-229	-31	4
1	-1	-26165	-13883	-6651	12533	-26166	-13990	-1411	2639
1	0	-294	-15521	381	33	-473	-15616	90	-12
1	1	90	-56	30	47	86	-163	18	9
1	2	0	0	0	0	1	-2	0	0
2	-4	0	0	0	0	-1	1	0	0
2	-3	-24	36	36	28	-74	71	11	11
2	-2	-7290	5072	3612	5192	-7322	5078	761	1096
2	-1	-4705	716	362	2203	-4754	746	72	459
2	0	109	-559	30	12	77	-554	6	-1
2	1	4	0	0	2	5	-4	0	1
3	-4	-2	-3	-3	2	-3	-6	-1	0
3	-3	-56	-395	-324	47	-65	-388	-67	11
3	-2	-1366	994	697	961	-1369	993	147	203
3	-1	-477	126	62	217	-486	133	12	45
3	0	14	-26	2	2	11	-25	0	0
4	-5	0	0	0	0	1	0	0	0
4	-4	27	9	8	-23	27	9	2	-5
4	-3	-16	-102	-84	13	-17	-102	-18	3
4	-2	-178	136	94	124	-179	135	20	76
4	-1	-42	13	6	19	-43	14	1	4
4	0	1	-1	0	0	1	-1	0	0
5	-5	-2	2	2	2	-2	2	0	0
5	-4	9	3	3	-8	9	3	1	-2
5	-3	-3	-17	-14	2	-3	-17	-3	1
5	-2	-20	16	11	14	-20	16	2	3
5	-1	-4	1	1	1	-4	1	0	0
6	-5	-1	1	1	1	-1	1	0	0
6	-4	2	1	1	-2	2	1	0	0
6	-3	0	-2	-2	0	0	-2	0	0
6	-2	-2	2	1	1	-2	2	0	0

Secular Terms
d) Jupiter on Venus

J	DX (IN UNITS OF 10**(-16)) (TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)		DY		DZ	
	COS	SIN	COS	SIN	COS	SIN
0	4490422	0	-6474580	0	-62291	0
1	15367	7386	7386	25613	6067107	-14726728
2	-1496667	2158143	-2158092	-1496632	20763	-50399
3	-15366	22157	-22157	-15366	107	-259
4	-140	202	-202	-140	0	-2
5	-1	2	-2	-1	0	0

J	NDZ (THE TERMS ARE IN UNITS OF 10**(-6) SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)		NU U/COS(I)		U/COS(I)	
	COS	SIN	COS	SIN	COS	SIN
0	60	0	10	0	-64	0
1	-8804	-6106	3053	-4402	6187	-15018
2	-15	-10	10	-15	21	-51

Table A-2. (Cont.)
 Periodic Terms
 e) Saturn on Venus

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	277	0	93	0	22	0	0	0	
0	1	-15068	-28	-25	-15199	0	0	0	0	
0	2	70	92	-93	70	0	-6	0	0	
0	3	-10	5	-5	-10	0	0	0	0	
1	-4	-13	-16	-16	13	0	0	0	0	
1	-3	-1352	-1554	-1554	1352	0	0	0	0	
1	-2	-122458	-104787	-104790	122460	73	128	0	0	
1	-1	367292	-252	-5644	-366877	-8301	1318	-24	4	
1	0	368661	308923	-305934	364580	-497	-257	-1	-1	
1	1	-357803	4302	-4309	-357805	9455	-2003	27	-6	
1	2	-3136	-459	459	-3136	32	-7	0	0	
1	3	-27	-5	5	-27	0	0	0	0	
2	-5	0	2	2	0	0	0	0	0	
2	-4	56	234	234	-56	0	0	0	0	
2	-3	3547	18367	18366	-3547	0	4	0	0	
2	-2	-5131	20925	20693	4957	-61	-181	0	-1	
2	-1	-7899	-113970	110054	-36553	-22915	-54900	-65	-157	
2	0	14657	-60745	60855	14432	169	568	0	2	
2	1	-13672	1599	-1600	-13673	376	-96	1	0	
2	2	-131	-6	6	-131	1	0	0	0	
2	3	-1	0	0	-1	0	0	0	0	
3	-5	-2	5	5	2	0	0	0	0	
3	-4	-125	303	303	125	0	0	0	0	
3	-3	756	3749	3755	-768	0	2	0	0	
3	-2	1304	719	6122	1582	-57	134	0	0	
3	-1	-3944	-22893	22402	-5345	-3030	-7222	-9	-71	
3	0	368	-9812	9817	353	25	78	0	0	
3	1	-656	186	-186	-656	19	-6	0	0	
3	2	-7	0	0	-7	0	0	0	0	
4	-5	-8	4	4	8	0	0	0	0	
4	-4	-37	80	80	37	0	0	0	0	
4	-3	227	483	580	2	-4	3	0	0	
4	-2	413	-378	1168	401	-15	43	0	0	
4	-1	-638	-3198	3148	-711	-315	-741	-1	-2	
4	0	-22	-1114	1114	-23	3	8	0	0	
4	1	-34	18	-18	-34	1	0	0	0	
5	-5	-3	1	1	3	0	0	0	0	
5	-4	0	16	13	13	0	0	0	0	
5	-3	56	46	82	28	-2	1	0	0	
5	-2	74	-99	181	71	-3	8	0	0	
5	-1	-82	-381	377	-85	-30	-69	0	0	
5	0	-5	-112	112	-5	0	0	0	0	
5	1	-2	2	-2	-2	0	0	0	0	
6	-4	2	3	1	4	0	0	0	0	
6	-3	11	3	11	8	0	0	0	0	
6	-2	11	-17	24	10	0	1	0	0	
6	-1	-9	-42	41	-10	-3	-6	0	0	
6	0	0	-11	11	0	0	0	0	0	
7	-3	2	0	1	1	0	0	0	0	
7	-2	1	-2	3	1	0	0	0	0	
7	-1	-1	-4	4	-1	0	0	0	0	

Table A-2. (Cont.)
e) Saturn on Venus

J	K	NDZ ----- (IN UNITS OF 10**(-4)) -----		NU SECONDS OF ARC) -----		D (LONG.) -----		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-43	0	0	0	-9	0
0	1	0	0	1	1	0	0	0	0
1	-2	-12	4	4	9	-20	14	2	3
1	-1	-1175	1402	689	578	-1176	1388	144	122
1	0	-13	-2077	24	2	-21	-2067	4	0
1	1	6	-8	4	3	6	-22	2	1
2	-3	1	-1	-1	-1	3	-1	0	-1
2	-2	372	-73	-53	-268	373	-73	-11	-57
2	-1	230	57	27	-114	232	56	6	-24
2	0	-12	-80	2	-1	-10	-80	0	0
2	1	0	0	0	0	0	-1	0	0
3	-3	9	4	4	-7	9	4	1	-2
3	-2	75	-15	-11	-54	76	-15	-2	-11
3	-1	37	2	1	-18	38	1	0	-4
3	0	-1	-4	0	0	-1	-4	0	0
4	-3	2	1	1	-2	3	1	0	0
4	-2	11	-2	-2	-8	11	-2	0	-2
4	-1	4	0	0	-2	4	0	0	0
5	-2	1	0	0	-1	1	0	0	0

Secular Terms
e) Saturn on Venus

J	DX (IN UNITS OF 10**(-16)) (TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)		DY (IN UNITS OF 10**(-16))		D7	
	COS	SIN	COS	SIN	COS	SIN
0	97104	0	-78189	0	1358	0
1	332	89	89	554	-132277	-673314
2	-32365	26062	-26062	-32364	-453	-2304
3	-332	268	-268	-332	-2	-12
4	-3	2	-2	-3	0	0

J	NDZ (THE TERMS ARE IN UNITS OF 10**(-6) SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)		NU U/COS(I)		U/COS(I)	
	COS	SIN	COS	SIN	COS	SIN
0	1	0	0	0	1	0
1	-106	-132	66	-53	-135	-687
2	0	0	0	0	0	-2

Table A-2. (Cont.)
Periodic Terms
f) Uranus on Venus

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	6	0	0	0	0	0	0	0	
0	1	-282	2	2	-283	0	0	0	0	
0	2	3	0	0	3	0	0	0	0	
1	-3	-34	35	35	34	0	0	0	0	
1	-2	-3104	2678	2678	3104	0	-1	0	0	
1	-1	16276	41	116	-16276	-304	206	-1	1	
1	0	9698	-7971	7968	9445	-8	-5	0	0	
1	1	-16113	-115	115	-16113	442	333	1	1	
1	2	-153	0	0	-153	2	1	0	0	
1	3	-1	0	0	-1	0	0	0	0	
2	-4	1	-4	-4	-1	0	0	0	0	
2	-3	71	-332	-332	-71	0	0	0	0	
2	-2	99	-1308	-1307	-101	-10	9	0	0	
2	-1	-50	2014	-1983	-830	-3016	2631	-9	8	
2	0	-287	3883	-3881	-296	31	-28	0	0	
2	1	-386	3	-3	-386	14	10	0	0	
2	2	-4	0	0	-4	0	0	0	0	
3	-4	0	-3	-3	0	0	0	0	0	
3	-3	12	-55	-55	-12	0	0	0	0	
3	-2	36	-131	-180	-11	0	0	0	0	
3	-1	-68	332	-329	-80	-330	287	-1	1	
3	0	-69	459	-459	-69	3	-3	0	0	
3	1	-7	0	0	-7	0	0	0	0	
4	-3	2	-6	-6	0	0	0	0	0	
4	-2	5	-8	-20	0	0	0	0	0	
4	-1	-9	38	-38	-8	-28	24	0	0	
4	0	-8	41	-41	-8	0	0	0	0	
5	-2	0	0	-2	0	0	0	0	0	
5	-1	0	4	-4	0	-2	2	0	0	
5	0	0	3	-3	0	0	0	0	0	

		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	-1	0	0	0	0	0	
1	-1	30	36	18	-15	30	36	4	-3	
1	0	0	-93	0	0	1	-92	0	0	
1	1	0	0	0	0	0	-1	0	0	
2	-2	-7	-1	-1	5	-7	-1	0	1	
2	-1	-15	-1	-1	7	-15	-1	0	2	
2	0	0	-2	0	0	0	-2	0	0	
3	-2	-1	0	0	1	-1	0	0	0	
3	-1	-2	0	0	1	-2	0	0	0	

Table A-2. (Cont.)

Secular Terms

f) Uranus on Venus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-756	0	-2735	0	-100	0
1	-3	3	3	-4	9707	-13126
2	252	912	-912	252	33	-45
3	3	9	-9	3	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	0	0	-0	0	-0	0
1	-4	1	-1	-2	10	-13

Table A-2. (Cont.)
Periodic Terms
g) Neptune on Venus

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	2	0	0	0	0	0	0	0		
0	1	-86	0	0	-87	0	0	0	0		
0	2	1	0	0	1	0	0	0	0		
1	-3	0	-16	-16	0	0	0	0	0		
1	-2	-81	-1578	-1578	81	0	0	0	0		
1	-1	1774	-53	-43	-1780	-86	12	0	0		
1	0	291	4730	-4697	266	0	-2	0	0		
1	1	-1769	69	-69	-1769	65	2	0	0		
1	2	-16	-5	5	-16	0	0	0	0		
2	-4	-1	0	0	1	0	0	0	0		
2	-3	-108	14	14	108	0	0	0	0		
2	-2	-903	101	101	904	9	0	0	0		
2	-1	750	-82	84	486	2543	-153	7	0		
2	0	2699	-301	302	2697	-27	2	0	0		
2	1	-119	-3	3	-119	2	0	0	0		
2	2	-1	0	0	-1	0	0	0	0		
3	-3	-3	0	0	3	0	0	0	0		
3	-2	-17	6	-5	19	0	0	0	0		
3	-1	21	-3	3	16	50	-4	0	0		
3	0	54	-2	2	54	0	0	0	0		
3	1	-2	0	0	-2	0	0	0	0		

		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
1	-1	-18	1	1	9	-18	1	0	2	
1	0	0	-10	0	0	0	-10	0	0	
2	-2	0	2	2	0	0	2	0	0	
2	-1	1	10	5	-1	1	10	1	0	
2	0	0	-1	0	0	0	-1	0	0	

Table A-2. (Cont.)
 Secular Terms
 g) Neptune on Venus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	41	0	-1110	0	-4	0
1	0	1	1	0	389	-5284
2	-14	370	-370	-14	1	-18
3	0	4	-4	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	0	0	-0	0	-0	0
1	-2	0	0	-1	0	-5

Table A-3. Earth
Periodic Terms
a) Mercury on Earth

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-7601	0	2993	0	-2042	0	-4	0	
0	1	64782	-445	-244	64495	0	0	0	0	
0	2	-5438	3025	-2988	-5448	496	15	1	0	
0	3	213	-428	427	215	-25	18	0	0	
0	4	9	43	-43	8	1	-3	0	0	
0	5	-3	-3	3	-3	0	0	0	0	
1	-7	0	14	14	0	0	0	0	0	
1	-6	-330	778	778	330	2	-4	0	0	
1	-5	-37131	56970	56967	37129	0	-164	0	0	
1	-4	-2410	59470	58923	972	45	155	0	0	
1	-3	18539	-61467	31123	42466	2372	1360	5	3	
1	-2	2991	-17008	19008	-946	-755	-32	-2	0	
1	-1	840	1160	-1117	1791	169	346	0	1	
1	0	58655	27092	-27911	57918	3657	6671	8	14	
1	1	-165	13	-6	-164	53	32	0	0	
1	2	11	-16	16	12	-6	1	0	0	
1	3	0	6	-6	0	0	0	0	0	
2	-8	116	62	80	-112	0	0	0	0	
2	-7	-116	-73	65	46	8	-4	0	0	
2	-6	97	-100	-58	-158	-4	6	0	0	
2	-5	-144	330	329	161	0	-14	0	0	
2	-4	-132	-882	-890	121	14	24	0	0	
2	-3	1047	1281	1280	-1048	-31	-27	0	0	
2	-2	-51	-63	14	38	-15	55	0	0	
2	-1	98	112	-123	96	-7	-112	0	0	
2	0	5918	2747	-2815	5868	387	704	1	1	
2	1	0	-3	3	0	0	0	0	0	
2	7	0	1	0	0	0	0	0	0	
2	8	43	98	98	-43	0	0	0	0	
3	-8	-5	-4	-3	6	0	0	0	0	
3	-7	23	2	-7	-19	0	0	0	0	
3	-6	-48	41	41	48	0	-2	0	0	
3	-5	48	-154	-154	-46	0	4	0	0	
3	-4	66	257	253	-70	0	-6	0	0	
3	-3	61	60	80	-56	-11	10	0	0	
3	-2	6	21	-26	7	8	-21	0	0	
3	-1	7	9	-10	7	0	-6	0	0	
3	0	904	419	-429	898	58	107	0	0	
3	8	-6	-10	-10	6	0	0	0	0	
4	-8	6	2	0	-5	0	0	0	0	
4	-7	-20	0	9	11	0	0	0	0	
4	-6	25	-28	-29	-25	0	0	0	0	
4	-5	-9	50	49	7	0	0	0	0	
4	-4	10	31	34	-7	-4	0	0	0	
4	-3	6	11	2	-7	4	-3	0	0	
4	-2	0	3	-4	0	1	-3	0	0	
4	-1	1	1	-1	1	0	0	0	0	
4	0	163	76	-78	163	11	19	0	0	
4	8	11	14	14	-11	0	0	0	0	
5	-8	-4	-2	0	5	0	0	0	0	
5	-7	16	2	-10	-2	0	0	0	0	
5	-6	-5	9	8	5	0	0	0	0	
5	-5	-1	11	11	2	-1	0	0	0	
5	-4	1	5	4	-2	0	0	0	0	
5	-3	0	2	0	-1	0	0	0	0	
5	0	32	15	-15	32	2	4	0	0	
5	8	-19	-17	-17	19	0	0	0	0	
6	-8	5	1	-2	0	0	0	0	0	
6	-7	-9	-4	6	-6	0	0	0	0	
6	-6	-2	3	3	2	0	0	0	0	
6	-5	0	2	2	0	0	0	0	0	
6	0	7	3	-3	7	0	0	0	0	
6	8	21	14	14	-21	0	0	0	0	
7	-8	0	-2	2	1	0	0	0	0	
7	-7	3	3	-1	5	0	0	0	0	
7	0	2	0	0	1	0	0	0	0	
7	8	-13	-6	-5	13	0	0	0	0	
8	-8	3	0	0	3	0	0	0	0	

Table A-3. (Cont.)
a) Mercury on Earth

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	133	0	0	0	28	0
0	1	0	0	-25	12	0	0	-5	3
0	2	0	1	1	-1	0	1	0	0
1	-5	-1	-2	-1	1	2	0	0	0
1	-4	210	139	-14	21	213	140	-3	4
1	-3	159	4	-3	87	162	7	-1	19
1	-2	-34	28	-20	-26	-32	31	-4	-5
1	-1	-55	116	124	58	-55	117	26	12
1	0	1	-2	-1	0	1	0	0	0
1	1	-1	-1	1	-1	-1	-1	0	0
2	-4	1	0	0	1	1	0	0	0
2	-3	-2	0	0	-2	-2	0	0	0
2	-2	2	-2	3	3	2	-2	1	1
2	-1	-6	12	12	6	-6	12	3	1
3	-3	0	0	0	1	0	0	0	0
3	-1	-1	2	2	1	-1	2	0	0

Table A-3. (Cont.)
 Secular Terms
 a) Mercury on Earth

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	294776	0	468326	0	6869	0
1	2473	-1309	-1309	4121	-273009	481393
2	-98203	-156087	156065	-98189	-2289	4037
3	-2471	-3926	3926	-2470	-29	51
4	-55	-88	88	-55	0	0
5	-1	-2	2	-1	0	0

NDZ			NU		U/COS(I)	
(THE TERMS ARE IN UNITS OF 10**(-6) SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T						
WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)						
J	COS	SIN	COS	SIN	COS	SIN
0	-13	0	2	0	8	0
1	749	-471	236	374	-327	577
2	3	-2	2	3	-3	5

Table A-3. (Cont.)

Periodic Terms

b) Venus on Earth

		DX				DY				DZ				U/COS(1)	
		(IN UNITS OF 10 ⁻⁴ (-12))										(10 ⁻⁴ (-4) SECONDS OF ARC)			
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-20249	0	-8809	0	-867	0	0	0	-2	0	0	0	0	0
0	1	1450949	-7683	-8271	1436872	0	-4	0	0	0	0	0	0	0	0
0	2	28239	-8944	8467	27979	-4628	-5527	-10	-11	0	0	0	0	0	0
0	3	1364	-1447	1408	1364	-580	-236	-1	0	0	0	0	0	0	0
0	4	57	-111	109	57	-37	-9	0	0	0	0	0	0	0	0
0	5	0	-15	14	0	-3	0	0	0	0	0	0	0	0	0
0	6	0	-1	1	0	0	0	0	0	0	0	0	0	0	0
1	-7	0	2	2	0	0	0	0	0	0	0	0	0	0	0
1	-6	7	16	15	-7	1	0	0	0	0	0	0	0	0	0
1	-5	-1	42	39	2	-45	36	0	0	0	0	0	0	0	0
1	-4	-3483	-1783	-1829	3509	-659	896	-1	2	0	0	0	0	0	0
1	-3	-111944	-87328	-87779	112650	-5088	21875	-10	45	0	0	0	0	0	0
1	-2	-12591840	7034122	7020711	12643433	-31368	-437723	-65	-903	0	0	0	0	0	0
1	-1	19358	243243	-341374	-85902	15082	38389	31	79	0	0	0	0	0	0
1	0	7873335	-4387972	4372780	7869801	-1161117	-83778	-240	-173	0	0	0	0	0	0
1	1	133181	-72252	71906	133178	-6276	-2120	-9	-4	0	0	0	0	0	0
1	2	2977	-2746	2721	2992	-415	51	-1	0	0	0	0	0	0	0
1	3	55	-113	112	57	-24	9	0	0	0	0	0	0	0	0
1	4	-4	-10	10	-4	-1	2	0	0	0	0	0	0	0	0
2	-8	1	2	2	-1	0	0	0	0	0	0	0	0	0	0
2	-7	-9	42	42	9	-4	4	0	0	0	0	0	0	0	0
2	-6	-1338	1490	1487	1341	-37	80	0	0	0	0	0	0	0	0
2	-5	-78498	78063	78022	78561	-486	1568	-1	3	0	0	0	0	0	0
2	-4	-4773234	4910402	4909994	4774555	-15654	-48023	-32	-99	0	0	0	0	0	0
2	-3	11343282	-18247724	-18202836	-11249701	-174166	-267016	-359	-951	0	0	0	0	0	0
2	-2	3533696	-3668150	3783793	3614489	-44679	-28791	-92	-59	0	0	0	0	0	0
2	-1	-2865858	4657217	-4664347	-2862841	-111310	-13414	-230	-28	0	0	0	0	0	0
2	0	-73210	124257	-124446	-73099	-1882	290	-4	1	0	0	0	0	0	0
2	1	-2138	2021	-2032	2118	-223	175	0	0	0	0	0	0	0	0
2	2	-68	16	-16	-66	-11	13	0	0	0	0	0	0	0	0
2	3	-8	-3	3	-7	0	2	0	0	0	0	0	0	0	0
3	-9	-8	13	13	8	0	0	0	0	0	0	0	0	0	0
3	-8	-490	591	591	490	-2	9	0	0	0	0	0	0	0	0
3	-7	-26868	30568	30565	26873	49	248	0	1	0	0	0	0	0	0
3	-6	-1523473	172513	1725188	1523482	4727	13336	10	28	0	0	0	0	0	0
3	-5	-1370450	5265081	5262296	1368847	766	-5981	2	-12	0	0	0	0	0	0
3	-4	1929308	-4895991	-947681	1648659	-890635	-473979	-1856	-978	0	0	0	0	0	0
3	-3	542349	-2001862	2030138	541838	-19339	-3774	-40	-6	0	0	0	0	0	0
3	-2	-8618	364186	-367876	-4506	-48155	19657	-99	41	0	0	0	0	0	0
3	-1	-592	12252	-12322	-480	-888	493	-2	1	0	0	0	0	0	0
3	0	-470	-140	141	-452	-70	184	0	0	0	0	0	0	0	0
3	1	-31	-14	14	-30	-2	12	0	0	0	0	0	0	0	0
3	2	-6	0	0	-6	0	1	0	0	0	0	0	0	0	0
4	-10	1	5	5	-1	0	0	0	0	0	0	0	0	0	0
4	-9	-87	269	269	87	4	14	0	0	0	0	0	0	0	0
4	-8	-5765	14402	14403	5774	173	278	0	1	0	0	0	0	0	0
4	-7	-105538	466758	466765	105666	-3156	-2851	-7	-6	0	0	0	0	0	0
4	-6	-142939	-593191	-557422	162079	-37747	-5411	-78	-11	0	0	0	0	0	0
4	-5	-356529	-1093721	-572926	471862	144812	-3248	299	-7	0	0	0	0	0	0
4	-4	370007	120175	-108364	28504	-3548	2969	-7	6	0	0	0	0	0	0
4	-3	31493	68192	-69057	35154	-16794	21059	-35	43	0	0	0	0	0	0
4	-2	1117	2587	-2593	1194	-279	406	-1	1	0	0	0	0	0	0
4	-1	-384	-29	36	-372	20	136	0	0	0	0	0	0	0	0
4	0	-23	-2	2	-22	2	8	0	0	0	0	0	0	0	0
4	1	-4	2	-2	-4	0	0	0	0	0	0	0	0	0	0
5	-12	0	2	2	0	0	0	0	0	0	0	0	0	0	0
5	-11	1	123	123	0	0	1	0	0	0	0	0	0	0	0
5	-10	-87	6680	6680	88	3	783	-3	-2	0	0	0	0	0	0
5	-9	1183	399819	399597	-1174	-1511	-783	-5	-2	0	0	0	0	0	0
5	-8	-150221	-466324	-463049	151078	-5587	453	-12	1	0	0	0	0	0	0
5	-7	-108268	-451146	235009	103518	78624	-28625	162	-59	0	0	0	0	0	0
5	-6	-276492	-89602	-351063	365064	34846	-20204	72	-42	0	0	0	0	0	0
5	-5	18119	18398	-15205	9941	-1173	2666	-2	5	0	0	0	0	0	0
5	-4	12128	9764	-9068	14597	-2455	14695	-5	30	0	0	0	0	0	0
5	-3	552	469	-453	593	-39	242	0	0	0	0	0	0	0	0
5	-2	-254	88	-79	-249	60	76	0	0	0	0	0	0	0	0
5	-1	-15	6	-5	-15	4	4	0	0	0	0	0	0	0	0
5	0	-2	3	-3	-2	0	0	0	0	0	0	0	0	0	0
6	-13	0	2	2	0	0	0	0	0	0	0	0	0	0	0
6	-12	32	136	136	-32	2	1	0	0	0	0	0	0	0	0
6	-11	1555	7720	7720	-1554	87	31	0	0	0	0	0	0	0	0
6	-10	28452	49634	49593	-28444	-300	-34	-1	0	0	0	0	0	0	0
6	-9	-32176	-37097	-16861	26728	-6899	3495	-14	7	0	0	0	0	0	0
6	-8	-72147	-39091	3438	47769	-6852	12	-14	-7	0	0	0	0	0	0
6	-7	-180628	-13599	-21460	190169	8280	-13907	17	-29	0	0	0	0	0	0
6	-6	7237	933	-1937	1690	161	1834	0	4	0	0	0	0	0	0
6	-5	2627	979	259	3870	2883	8095	6	17	0	0	0	0	0	0
6	-4	181	56	-39	198	30	119	0	0	0	0	0	0	0	0
6	-3	-128	132	-124	-128	63	26	0	0	0	0	0	0	0	0
6	-2	-8	8	-8	-8	1	0	0	0	0	0	0	0	0	0
6	-1	0	2	-2	0	0	0	0	0	0	0	0	0	0	0
7	-14	2	3	3	-2	0	0	0	0	0	0	0	0	0	0
7	-13	112	184	184	-112	3	0	0	0	0	0	0	0	0	0
7	-12	5619	7085	7085	-5618	-75	13	0	0	0	0	0	0	0	0
7	-11	-12251	-7208	-4834	12077	-434	362	-1	1	0	0	0	0	0	0
7	-10	-16595	-7065	1975	9364	1748	-2580	4	-5	0	0	0	0	0	0
7	-9	-27480	8320	5193	33018	728	-3324	2	-7	0	0	0	0	0	0
7	-8	-87262	39121	38597	89880	240	-7701	0	-16	0	0	0	0	0	0
7	-7	2720	-1489	-961	-44	669	983	1	2	0	0	0	0	0	0
7	-6	-12	540	817	317	3837	3371	8	7	0	0	0	0	0	0
7	-5	31	13	-3	35	36	51	0	0	0	0	0	0	0	0
7	-4	-37	122	-117	-40	48	-6	0	0	0	0	0	0	0	0
7	-3	-2	8	-8	-3	2	0	0	0	0	0	0	0	0	0
7	-2	0	2	-2	0	0	0	0	0	0	0	0	0	0	0
8	-17	22	19	19	-22	0	0	0	0	0	0	0	0	0	0
8	-16	1099	954	954	-1099	0	0	0	0	0	0	0	0	0	0

Table A-3. (Cont.)

b) Venus on Earth

8	-15	58250	50563	50561	-58248	-5	2	0	0
8	-14	3476095	3014600	3014387	-3475850	-679	262	-1	1
8	-13	-236871	-92962	-92068	236187	-464	1095	-1	2
8	-12	-3461625	-2998518	2998811	-3456879	17625	-42256	36	-87
8	-11	14687	-17771	21671	25985	212	-1145	0	-2
8	-10	-11393	11118	11472	13941	-464	-1554	-1	-3
8	-9	-31787	42126	42362	32415	-1828	-3562	-4	-7
8	-8	710	-1452	-937	-99	700	348	1	1
8	-7	-205	826	-24	-396	3035	657	6	1
8	-6	-7	39	-35	-5	25	19	0	0
8	-5	17	89	-87	13	28	-21	0	0
8	-4	1	7	-7	1	1	-1	0	0
8	-3	1	1	-1	1	0	0	0	0
9	-16	45	23	23	-45	0	0	0	0
9	-15	740	153	153	-740	-4	4	0	0
9	-14	-830	84	157	706	-19	86	0	0
9	-13	-1349	493	640	630	-23	-197	0	0
9	-12	-1927	2346	2396	2192	-145	-313	0	-1
9	-11	-3161	9291	9383	3328	-621	-604	-1	-1
9	-10	-4257	29880	30001	4326	-1828	-1228	-4	-3
9	-9	-125	-955	-750	211	519	-26	1	0
9	-8	125	788	-375	-259	1839	-558	4	-1
9	-7	8	62	-62	11	16	7	0	0
9	-6	41	53	-54	38	10	-22	0	0
9	-5	4	5	-5	4	0	-1	0	0
9	-4	1	0	0	1	0	0	0	0
10	-18	4	0	0	-4	0	0	0	0
10	-17	231	9	9	-230	0	1	0	0
10	-16	-337	110	112	331	0	9	0	0
10	-15	-348	139	151	7	-22	-75	0	0
10	-14	-201	458	516	370	-41	-57	0	0
10	-13	-325	1747	1780	364	-145	-104	0	0
10	-12	1050	5889	5935	-1021	-479	-130	-1	0
10	-11	6313	16559	16558	-6337	-1257	-109	-3	0
10	-10	-398	-489	-439	401	295	-186	1	0
10	-9	385	540	-425	20	839	-868	2	-2
10	-8	44	66	-65	49	10	2	0	0
10	-7	48	23	-25	46	-2	-17	0	0
10	-6	5	2	-2	5	0	0	0	0
10	-5	1	0	0	1	0	0	0	0
11	-18	143	-76	-76	-143	0	0	0	0
11	-17	-117	53	28	-45	12	24	0	0
11	-16	-90	123	66	-19	-11	-11	0	0
11	-15	0	310	321	8	-31	-14	0	0
11	-14	351	1021	1031	-349	-102	-11	0	0
11	-13	2365	2910	2927	-2363	-288	72	-1	0
11	-12	8103	6840	6786	-8107	-682	303	-1	1
11	-11	-416	-160	-145	420	111	-207	0	0
11	-10	490	255	-311	242	198	-742	0	-2
11	-9	83	43	-40	90	7	0	0	0
11	-8	45	0	-2	45	-7	-10	0	0
11	-7	6	0	0	6	0	0	0	0
11	-6	0	0	0	1	0	0	0	0
11	-5	1	0	0	-1	0	0	0	0
11	-4	69	-11	-11	-69	0	0	0	0
12	-18	-4	19	19	4	0	0	0	0
12	-17	5	58	47	-12	-6	-2	0	0
12	-16	92	165	168	-91	-18	2	0	0
12	-15	507	446	446	-509	-57	24	0	0
12	-14	2230	896	902	-2231	-134	125	0	0
12	-13	6291	1254	1195	-6257	-274	362	-1	1
12	-12	-337	43	61	330	-3	-158	0	0
12	-11	489	4	-119	370	-121	-479	0	-1
12	-10	111	-3	10	116	5	-2	0	0
12	-9	38	-18	18	38	-8	-4	0	0
12	-8	5	-3	4	5	0	0	0	0
12	-7	0	-1	1	0	0	0	0	0
12	-6	7	-11	-11	-7	0	0	0	0
13	-18	20	24	23	-20	3	0	0	0
13	-17	107	76	49	-98	-9	6	0	0
13	-16	422	86	83	-422	-24	31	0	0
13	-15	1557	-194	-190	-1558	-35	110	0	0
13	-14	3703	-1168	-1203	-3638	-41	283	0	1
13	-13	-232	159	170	198	-54	-91	0	0
13	-12	421	-209	112	399	-220	-234	0	0
13	-11	112	-67	77	115	2	-3	0	0
13	-10	25	-33	33	26	-7	0	0	0
13	-9	3	-6	6	3	0	0	0	0
13	-8	0	-1	1	0	0	0	0	0
13	-7	-11	-33	-33	11	0	0	0	0

Table A-3. (Cont.)

b) Venus on Earth

14	-18	82	6	0	-76	5	-11	0	0
14	-17	307	-70	-109	-214	-4	26	0	0
14	-16	845	-613	-611	-844	14	72	0	0
14	-15	1605	-1661	-1659	-1527	66	174	0	0
14	-14	-123	222	204	69	-61	-34	0	0
14	-13	292	-396	349	315	-202	-64	0	0
14	-12	78	-135	146	75	0	-2	0	0
14	-11	8	-43	44	8	-4	3	0	0
14	-10	0	-7	8	0	0	0	0	0
14	-9	0	-1	1	0	0	0	0	0
14	17	-2	-1	-1	2	0	0	0	0
14	18	-119	-47	-47	119	2	-1	0	0
15	-18	128	-139	-129	-101	-15	-38	0	0
15	-17	458	-722	-553	-146	31	35	0	0
15	-16	368	-1250	-1203	-287	98	82	0	0
15	-15	-11	249	187	-41	-45	2	0	0
15	-14	83	-544	546	107	-139	29	0	0
15	-13	2	-186	195	-6	-2	0	0	0
15	-12	-15	-46	47	-15	-2	3	0	0
15	-11	-5	-7	7	-5	0	0	0	0
15	-10	-1	0	0	-1	0	0	0	0
15	17	-9	4	4	9	0	0	0	0
15	18	-426	226	226	426	0	-7	0	0
16	-18	21	-560	-424	72	-83	-29	0	0
16	-17	34	-1172	26	278	91	16	0	0
16	-16	112	225	149	-122	-23	16	0	0
16	-15	-215	-610	639	-222	-73	64	0	0
16	-14	-107	-197	202	-120	-2	1	0	0
16	-13	-39	-38	38	-41	0	3	0	0
16	-12	-9	-4	4	-9	0	0	0	0
16	-11	-2	0	0	-2	0	0	0	0
16	17	-19	39	39	19	0	0	0	0
16	18	-381	1570	1569	380	-21	-20	0	0
17	-18	-129	-176	-33	-52	-235	83	0	0
17	-17	-649	-1162	1396	-1062	-7	15	0	0
17	-16	-605	-560	584	-652	-23	66	0	0
17	-15	-229	-145	143	-244	-1	3	0	0
17	-14	-61	-16	16	-62	1	2	0	0
17	-13	-11	0	0	-11	0	0	0	0
17	-12	-2	0	0	-2	0	0	0	0
17	16	1	0	0	-1	0	0	0	0
17	17	55	57	56	-55	0	0	0	0
17	18	2455	3733	3730	-2455	-53	9	0	0
18	-18	-718	-584	581	-1221	-14	-26	0	0
18	-17	-2955	-867	855	-3031	9	51	0	0
18	-16	-378	-34	24	-392	1	4	0	0
18	-15	-72	17	-19	-73	2	2	0	0
18	-14	-11	7	-7	-11	0	0	0	0
18	-13	-1	2	-2	-1	0	0	0	0
18	15	0	-1	-1	0	0	0	0	0
18	16	4	0	0	-4	0	0	0	0
18	17	387	209	207	-386	0	1	0	0
18	18	6317	1953	1943	-6304	-153	180	0	0

Table A-3. (Cont.)

b) Venus on Earth

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))			
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	2980	0	0	0	627	0
0	1	0	0	66	-36	0	0	14	-8
0	2	-14	-13	17	-20	-14	-13	4	-4
0	3	0	0	1	-1	-1	-1	0	0
1	-4	0	1	2	1	-1	2	0	0
1	-3	-17	57	51	17	-26	65	12	4
1	-2	-1072	-357	-28	271	-678	353	69	15
1	-1	23548	42271	-9789	5455	23529	42264	-2061	1147
1	0	-58	-24	-53	-7	336	685	-86	40
1	1	-13	-2	3	-18	-5	12	-1	-3
1	2	0	0	0	-1	0	0	0	0
2	-5	0	2	3	0	7	9	1	-1
2	-4	15	71	56	-10	311	359	42	-33
2	-3	18679	17755	-2576	2606	17885	17264	-594	632
2	-2	-47319	-29315	17225	-27804	-47010	-29019	3595	-5821
2	-1	-209	-113	153	-251	-996	-598	83	-136
2	0	-8	1	-1	-13	-28	-12	1	-5
2	1	0	0	0	0	-1	0	0	0
3	-7	0	0	0	0	3	3	0	0
3	-6	6	6	5	-4	135	121	13	-15
3	-5	7393	6771	565	-582	7643	6836	126	-149
3	-4	15088	3884	-1760	6772	15098	3992	-383	1451
3	-3	-6796	-307	227	-5089	-6541	-240	41	-1044
3	-2	-26	-3	3	-43	-135	-7	1	-20
3	-1	-3	3	-5	-5	-6	3	-1	-1
4	-8	0	0	0	0	2	1	0	0
4	-7	47	27	10	-16	72	33	3	-6
4	-6	1527	329	-98	430	1504	336	-20	93
4	-5	-1386	360	-250	-933	-1391	381	-51	-190
4	-4	-1864	924	-791	-1597	-1887	930	-167	-339
4	-3	-4	-1	-3	-12	-36	15	-2	-6
4	-2	-1	3	-5	-1	-2	3	-1	0
5	-10	0	0	0	0	1	0	0	0
5	-9	2	1	1	-1	28	1	0	-3
5	-8	1554	-14	-1	121	1533	-8	1	28
5	-7	-1234	397	-219	-674	-1212	401	-46	-139
5	-6	-248	231	-194	-204	-276	250	-40	-44
5	-5	-475	690	-638	-439	-480	694	-135	-93
5	-4	-1	-2	-2	-3	-9	9	-2	-2
5	-3	1	2	-3	1	0	2	-1	0
6	-11	0	0	0	0	1	0	0	0
6	-10	35	-5	-1	-6	37	-7	0	-1
6	-9	147	-85	34	59	147	-84	7	13
6	-8	-63	70	-52	-46	-61	71	-11	-9
6	-7	-39	124	-115	-35	-41	131	-24	-7
6	-6	-37	390	-378	-36	-38	392	-80	-8
6	-5	-1	-2	0	-2	-2	4	-1	0
6	-4	1	1	-2	2	1	1	0	0
7	-12	1	0	0	0	1	-1	0	0
7	-11	24	-20	4	5	24	-19	1	1
7	-10	-18	30	-19	-11	-17	30	-4	-2
7	-9	-6	28	-24	-5	-6	30	-5	-1
7	-8	12	61	-60	13	14	64	-12	3
7	-7	80	184	-183	80	81	185	-39	17
7	-6	-2	-1	0	-1	-1	2	0	0
7	-5	1	0	0	1	1	0	0	0

Table A-3. (Cont.)

b) Venus on Earth

9	-15	0	0	0	0	4	-5	-1	-1
8	-14	1	0	0	0	209	-240	-25	-22
8	-13	12409	-14318	37	34	12405	-14307	9	8
8	-12	-254	649	-326	-127	-46	409	-43	-5
8	-11	-1	9	-8	-1	-1	15	-2	0
8	-10	4	12	-11	4	4	12	-2	1
8	-9	22	25	-26	23	23	26	-5	5
8	-8	86	66	-67	88	87	66	-14	19
8	-7	-2	0	0	-1	0	1	0	0
8	-6	1	0	0	1	1	0	0	0
9	-14	0	-2	1	0	0	-2	0	0
9	-13	0	2	-1	0	0	2	0	0
9	-12	1	2	-2	1	1	2	0	0
9	-11	5	4	-4	5	5	4	-1	1
9	-10	18	7	-7	19	19	7	-1	4
9	-9	61	9	-9	63	61	9	-2	13
9	-8	-1	0	0	-1	0	1	0	0
9	-7	0	0	0	1	0	0	0	0
10	-16	0	-1	0	0	0	-1	0	0
10	-15	0	1	-1	0	0	1	0	0
10	-13	1	1	-1	1	1	1	0	0
10	-12	3	1	-1	4	4	1	0	1
10	-11	11	-2	2	12	12	-2	0	3
10	-10	33	-13	14	35	33	-13	3	7
10	-9	-1	1	-1	0	0	1	0	0
11	-14	1	0	0	1	1	0	0	0
11	-13	2	-1	1	2	2	-1	0	0
11	-12	6	-4	5	6	6	-5	1	1
11	-11	14	-16	18	15	14	-16	4	3
11	-10	0	1	0	0	0	1	0	0
12	-14	1	-1	1	1	1	-1	0	0
12	-13	2	-4	5	2	2	-5	1	0
12	-12	2	-12	14	3	2	-12	3	1
12	-11	0	1	0	0	0	1	0	0
13	-15	0	-1	1	0	0	-1	0	0
13	-14	0	-3	3	0	0	-3	1	0
13	-13	-2	-7	8	-3	-2	-7	2	-1
13	-12	0	1	0	0	0	0	0	0
14	-16	0	0	1	0	0	0	0	0
14	-15	-1	-2	2	-1	-1	-2	0	0
14	-14	-3	-3	4	-4	-3	-3	1	-1
14	-13	1	0	0	0	1	0	0	0
15	-16	-1	-1	1	-1	-1	-1	0	0
15	-15	-1	0	1	-4	-1	0	0	-1
15	-14	1	0	0	0	1	0	0	0
15	-19	0	1	-1	0	0	1	0	0
16	-18	1	0	0	-1	1	0	0	0
16	-17	-1	0	0	-1	-1	0	0	0
16	-16	0	0	-1	-2	0	0	0	-1
16	-15	1	0	0	0	1	0	0	0
16	-19	3	1	-1	3	3	1	0	1
17	-18	3	-2	-2	-3	3	-2	0	-1
17	-17	1	-1	-1	-1	1	-1	0	0
17	-16	1	-1	0	0	1	-1	0	0
17	-19	8	-5	5	8	8	-5	1	2
18	-19	1	-2	-2	-1	1	-2	0	0
18	-18	2	-6	-6	-2	2	-6	-1	0
18	-17	0	-1	0	0	0	-1	0	0
18	-18	0	0	1	0	0	-1	0	0
18	-19	4	-13	13	4	4	-13	3	1

Table A-3. (Cont.)

Secular Terms

b) Venus on Earth

J	DX		DY		DZ	
	COS	SIN	COS	SIN	COS	SIN
0	-2680183	0	-11514524	0	890182	0
1	-26091	32189	32189	-41077	-35381478	16513938
2	892892	3837635	-3837095	892766	-296672	138472
3	22464	96533	-96526	22462	-3731	1742
4	502	2158	-2158	502	-56	26
5	11	47	-47	11	0	0
6	0	1	-1	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**(-6)}$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	309	0	-22	0	1067	0
1	-18411	4286	-2143	-9205	-42425	19801
2	-77	18	-18	-77	-356	166
3	-1	0	0	-1	-4	2

Table A-3. (Cont.)
Periodic Terms
c) Mars on Earth

		DX		DY		DZ		U/COS(1)	
		(IN UNITS OF 10**(-12))							
		(10**(-4) SECONDS OF ARC)							
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	6355	0	5133	0	-3056	0	-6	0
0	1	-29869	-1111	-767	-30035	0	0	0	0
0	2	5337	5143	-5133	5366	104	933	0	2
0	3	50	121	-120	52	33	-26	0	0
0	4	0	6	-4	-1	-3	0	0	0
0	5	0	0	-1	0	0	0	0	0
0	6	-1	0	0	0	0	0	0	0
0	7	0	2	0	-1	0	0	0	0
0	8	1	0	0	1	0	0	0	0
1	-10	0	-1	-1	0	0	0	0	0
1	-9	-1	0	1	0	0	0	0	0
1	-8	2	0	0	-2	0	0	0	0
1	-7	0	-2	0	2	0	0	0	0
1	-6	-1	0	0	-1	0	0	0	0
1	-5	5	-3	-4	-3	0	0	0	0
1	-4	147	-171	-169	-146	-16	3	0	0
1	-3	6692	-7861	-7854	-6692	233	133	0	0
1	-2	295620	-384811	-384529	-296029	-130	-9822	0	-20
1	-1	138185	-13217	-16496	-141383	5670	-5625	12	-12
1	0	-497676	658804	-652084	-504699	-17467	4484	-36	9
1	1	-87806	17389	-17542	-87797	-2957	-1665	-6	-3
1	2	-2346	-218	216	-2344	-1	110	0	0
1	3	-58	-15	15	-57	5	-5	0	0
1	4	-1	0	0	-2	0	0	0	0
1	5	-1	0	0	0	0	0	0	0
1	6	0	0	1	0	0	0	0	0
1	7	0	1	0	0	0	0	0	0
2	-11	0	0	0	-1	0	0	0	0
2	-10	0	-2	-2	0	0	0	0	0
2	-9	-2	1	2	0	0	0	0	0
2	-8	2	1	-1	-2	0	0	0	0
2	-7	0	-1	0	1	0	0	0	0
2	-6	6	29	29	-8	0	0	0	0
2	-5	349	1322	1320	-348	3	-6	0	0
2	-4	16488	59647	59647	-16481	-87	42	0	0
2	-3	725041	2430494	2430287	-724705	2481	2168	5	4
2	-2	1543263	-4178633	-4224070	-1519293	5223	46781	11	96
2	-1	-2077259	-7042938	7079604	-1882729	4871	-14343	10	-30
2	0	-1422518	3767238	-3766670	-1423424	3923	-16591	81	-34
2	1	4768	60738	-60746	4763	7	-295	0	-1
2	2	295	1116	-1117	295	6	15	0	0
2	3	7	20	-21	8	0	0	0	0
2	4	0	1	0	0	0	0	0	0
2	5	1	0	0	0	0	0	0	0
3	-12	-2	0	0	1	0	0	0	0
3	-11	2	2	0	-2	0	0	0	0
3	-10	0	-3	-2	2	0	0	0	0
3	-9	-3	1	3	0	0	0	0	0
3	-8	2	2	-2	0	0	0	0	0
3	-7	3	-1	1	-1	0	0	0	0
3	-6	97	16	16	-99	1	2	0	0
3	-5	3736	1166	1158	-3734	3	-29	0	0
3	-4	110106	55599	55358	-110152	-1139	381	-2	1
3	-3	275130	724681	719195	-282499	4358	2760	9	6
3	-2	-456087	-163574	181956	-437239	6400	12627	13	26
3	-1	-462449	-1183013	1183518	-459989	3035	-10726	6	-22
3	0	-520	-23149	23177	-563	1007	-619	2	-1
3	1	137	-407	407	136	-38	-23	0	0
3	2	9	-8	7	8	0	3	0	0
4	-13	0	-2	-2	0	0	0	0	0
4	-12	-3	0	2	2	0	0	0	0
4	-11	2	2	0	-3	0	0	0	0
4	-10	0	-3	-2	2	0	0	0	0
4	-9	-3	0	2	0	0	0	0	0
4	-8	0	3	-1	0	0	0	0	0
4	-7	-18	22	24	19	-1	0	0	0
4	-6	-882	524	527	874	7	0	0	0
4	-5	-29864	4859	5042	29738	174	-521	0	-1
4	-4	-628017	-165080	-158611	629091	-1815	498	-4	1
4	-3	767543	1319104	1432891	-596247	-37629	-7334	-78	-15
4	-2	1706127	477798	-495114	1698097	4972	5724	10	12
4	-1	-552874	-1149582	1149582	-552636	-1532	9046	-3	19
4	0	-11295	-18926	18927	-11297	97	4	0	0
4	1	-232	-362	363	-232	-6	-2	0	0
4	2	-4	-7	6	-4	0	0	0	0
5	-15	-1	0	0	1	0	0	0	0
5	-14	0	2	1	-1	0	0	0	0
5	-13	1	-3	-3	0	0	0	0	0
5	-12	-4	0	3	2	0	0	0	0
5	-11	3	3	0	-4	0	0	0	0
5	-10	1	-4	-1	3	0	0	0	0
5	-9	-3	0	1	-1	0	0	0	0
5	-8	-9	-7	10	0	0	0	0	0
5	-7	-126	-234	-229	134	3	4	0	0
5	-6	-1427	-2709	-2727	1614	148	219	0	0
5	-5	-68604	46956	43816	71277	154	-627	0	-1
5	-4	-385524	-368889	-107093	377681	-6553	5575	-14	11
5	-3	258789	-178350	200941	245247	-6988	-641	-14	-1
5	-2	585000	107714	-108262	584789	3423	3697	7	8
5	-1	5825	-2322	2327	-5840	-5	437	0	1
5	0	61	-95	95	62	15	-8	0	0
5	1	0	0	0	0	-1	0	0	0
6	-15	-2	0	0	2	0	0	0	0
6	-14	2	3	2	-3	0	0	0	0
6	-13	2	-4	-4	1	0	0	0	0
6	-12	-5	0	4	2	0	0	0	0
6	-11	3	4	-2	-4	0	0	0	0
6	-10	3	-3	0	3	0	0	0	0
6	-9	4	-3	-1	-8	0	0	0	0
6	-8	106	20	10	-106	-5	2	0	0

Table A-3. (Cont.)

c) Mars on Earth

6	-7	861	337	229	-965	-130	-6	0	0
6	-6	2435	-15897	-16010	-4938	202	266	0	1
6	-5	143318	-151915	-133754	-162974	-1	-2376	0	-5
6	-4	-274957	45982	-99874	276331	10419	-11696	21	-24
6	-3	-397872	357872	-357374	-393993	-3207	486	-7	1
6	-2	204802	24833	-24874	206769	-1702	-1495	-4	-3
6	-1	4073	568	-568	4074	-14	37	0	0
6	0	77	3	-3	78	2	-2	0	0
6	1	1	0	0	0	0	0	0	0
7	-17	0	1	0	-1	0	0	0	0
7	-16	2	-2	-2	-1	0	0	0	0
7	-15	-4	0	1	4	0	0	0	0
7	-14	3	5	2	-5	0	0	0	0
7	-13	3	-6	-5	3	0	0	0	0
7	-12	-6	0	5	0	0	0	0	0
7	-11	2	5	-3	-2	0	0	0	0
7	-10	2	1	5	3	0	0	0	0
7	-9	-35	28	34	27	0	-5	0	0
7	-8	-254	50	133	237	41	-51	0	0
7	-7	3030	64	1294	-2175	-178	-3	0	0
7	-6	3996	-50916	-48850	6782	706	466	1	1
7	-5	120867	-172253	-137971	-164581	-1305	-6931	-3	-14
7	-4	9417	179406	-179590	22486	1830	-2324	4	-5
7	-3	-202275	221912	-221826	-202340	-2267	444	-5	1
7	-2	-658	3197	-3200	-659	-129	-79	0	0
7	-1	30	72	-72	29	0	7	0	0
7	18	3	0	0	-3	0	0	0	0
8	-18	0	-1	0	1	0	0	0	0
8	-17	-1	3	1	-3	0	0	0	0
8	-16	3	-3	-4	-1	0	0	0	0
8	-15	-7	0	3	6	0	0	0	0
8	-14	4	7	2	-7	0	0	0	0
8	-13	4	-7	-5	0	0	0	0	0
8	-12	-6	-2	5	-2	0	0	0	0
8	-11	-1	3	-5	1	0	0	0	0
8	-10	2	-20	-16	8	3	2	0	0
8	-9	48	-64	-104	25	9	32	0	0
8	-8	-707	868	27	980	60	-76	0	0
8	-7	5389	7600	3398	-7396	-384	117	-1	0
8	-6	25601	69963	76370	-2243	1567	834	3	2
8	-5	4059	-69906	-28281	-71484	1671	5592	3	12
8	-4	-31791	-174168	174160	-32014	538	-1219	1	-3
8	-3	-26808	32288	-32277	-26810	598	-182	1	0
8	-2	-856	871	-671	-856	-10	-11	0	0
8	-1	-9	16	-16	-9	0	1	0	0
8	18	6	-3	-3	-6	0	0	0	0
9	-18	-2	-3	1	3	0	0	0	0
9	-17	-3	7	2	-7	0	0	0	0
9	-16	5	-6	-8	-1	0	0	0	0
9	-15	-10	-1	6	7	0	0	0	0
9	-14	4	9	0	-9	0	0	0	0
9	-13	6	-6	-3	7	0	0	0	0
9	-12	-4	-3	3	-5	0	0	0	0
9	-11	6	9	-2	-8	-2	0	0	0
9	-10	-5	28	5	-48	-16	-6	0	0
9	-9	-153	-411	-242	-335	14	52	0	0
9	-8	-1650	226	1975	704	76	-189	0	0
9	-7	23791	20454	9722	-27999	-607	320	-1	1
9	-6	48873	118087	128851	-19203	4527	1696	9	3
9	-5	-89897	-48997	-43155	-93137	362	1113	1	1
9	-4	-45731	-162873	162873	-45710	391	-1033	1	-2
9	-3	-1215	-1556	1557	-1215	47	-25	0	0
9	-2	-39	-16	17	-39	-2	-1	0	0
9	18	14	-8	-8	-14	0	0	0	0
10	-18	-5	-6	4	6	-1	0	0	0
10	-17	-7	15	0	-15	0	0	0	0
10	-16	8	-9	-12	0	0	0	0	0
10	-15	-13	-3	9	7	0	0	0	0
10	-14	2	11	-4	-8	0	0	0	0
10	-13	7	-3	2	7	0	0	0	0
10	-12	-7	-4	5	-2	0	-1	0	0
10	-11	-3	-15	23	12	7	-5	0	0
10	-10	205	17	183	-28	-11	0	0	0
10	-9	491	-569	42	-671	54	94	0	0
10	-8	-5472	-1029	3853	2445	67	-331	0	-1
10	-7	-28410	-3208	-17350	24193	-924	567	-2	1
10	-6	23147	5999	23425	12187	-2048	-561	-4	-1
10	-5	58482	23130	-23017	58545	301	449	1	1
10	-4	-2789	-9108	9106	-2788	-47	177	0	0
10	-3	-40	-238	-40	5	-1	0	0	0
10	-2	-3	-4	4	-3	0	0	0	0
10	17	0	2	2	0	0	0	0	0
10	18	30	-19	-19	-30	0	0	0	0
11	-18	-10	-13	10	11	-2	1	0	0
11	-17	-14	28	-5	-28	0	0	0	0
11	-16	11	-11	-15	3	0	0	0	0
11	-15	-13	-6	12	3	0	0	0	0
11	-14	-2	11	-8	-5	0	0	0	0
11	-13	8	-2	2	7	0	0	0	0
11	-12	7	7	-12	8	0	4	0	0
11	-11	-35	88	-82	46	14	-9	0	0
11	-10	49	309	61	-267	-58	-9	0	0
11	-9	1223	-672	-923	1703	115	135	0	0
11	-8	-19448	5896	12002	14021	20	-431	0	-1
11	-7	-91718	-19029	-34576	88366	-2576	2001	-5	4
11	-6	53924	-31056	32657	52695	-424	-134	-1	0
11	-5	110103	32258	-32261	110098	349	457	1	1
11	-4	1477	65	-65	1477	0	19	0	0
11	-3	27	-8	8	27	0	0	0	0
11	17	0	4	4	0	0	0	0	0
11	18	57	-44	-44	-57	0	-1	0	0
12	-18	-17	-25	23	16	-3	2	0	0
12	-17	-26	47	-19	-46	0	0	0	0
12	-16	15	-10	-14	9	0	0	0	0
12	-15	-11	-10	12	-4	0	0	0	0
12	-14	-5	10	-9	-2	0	0	0	0
12	-13	-5	0	1	-8	-2	-1	0	0
12	-12	-26	-47	14	-47	0	9	0	0
12	-11	-118	-47	65	84	-23	0	0	0
12	-10	-239	793	-345	-769	-97	4	0	0
12	-9	2450	-2012	-2037	1666	165	148	0	0
12	-8	6485	-9601	-3816	-11593	-3	-593	1	-1
12	-7	-5190	8520	-10259	3297	566	-519	1	0
12	-6	-18877	13965	-14009	-18852	-219	6	0	0

Table A-3. (Cont.)

c) Mars on Earth

12	-5	2237	678	-678	2236	-39	-41	0	0
12	-4	61	30	-30	60	0	2	0	0
12	-3	1	0	0	2	0	0	0	0
12	-17	1	8	8	14	0	0	0	0
12	18	96	-88	-89	-94	0	-2	0	0
13	-18	-28	-45	45	18	-3	3	0	0
13	-17	-42	70	-64	-63	0	0	0	0
13	-16	18	-4	-8	14	0	0	0	0
13	-15	-7	-12	9	-9	0	0	0	0
13	-14	0	0	0	4	0	0	0	0
13	-13	28	1	12	23	-4	-4	0	0
13	-12	39	-37	-38	-6	2	19	0	0
13	-11	-223	-370	406	59	32	-45	0	0
13	-10	-279	886	-941	-1108	-119	22	0	0
13	-9	3595	-15365	-15032	570	197	127	0	0
13	-8	73720	-70100	-66769	-79119	-264	-2501	-1	-5
13	-7	-1354	45349	-45942	281	139	-82	0	0
13	-6	-85787	76188	-76183	-85783	-359	34	-1	0
13	-5	-1092	1238	-1238	-1092	-7	-3	0	0
13	-4	-17	25	-25	-17	0	0	0	0
13	17	3	14	14	-3	0	0	0	0
13	18	140	-152	-152	-140	0	-4	0	0
14	-18	-38	-74	77	10	-3	4	0	0
14	-17	-58	89	-74	-70	0	0	0	0
14	-16	18	3	0	16	0	0	0	0
14	-15	-1	-4	0	0	0	0	0	0
14	-14	-9	12	-13	-4	3	0	0	0
14	-13	10	22	12	-4	-9	-6	0	0
14	-12	216	28	-141	157	9	30	0	0
14	-11	-347	-572	677	-11	32	-62	0	0
14	-10	108	1684	-335	-1389	-121	37	0	0
14	-9	2210	4370	4985	1449	262	159	1	0
14	-8	-2645	-3651	1804	-4402	50	273	0	1
14	-7	-728	-9130	9131	-745	45	-76	0	0
14	-6	-476	375	-376	-476	17	-4	0	0
14	-5	-18	9	-9	-18	0	0	0	0
14	17	7	24	24	-7	0	0	0	0
14	18	168	-216	-216	-168	0	-6	0	0
15	-18	-44	-101	104	-13	-3	4	0	0
15	-17	-64	91	-89	-62	0	0	0	0
15	-16	9	4	7	3	0	0	0	0
15	-15	-2	-8	7	-4	0	1	0	0
15	-14	-12	1	-5	2	6	-2	0	0
15	-13	-78	78	-25	-105	-17	-7	0	0
15	-12	387	71	-192	307	17	37	0	0
15	-11	7	-138	1184	-507	26	-67	0	0
15	-10	19613	20965	19111	-20572	-89	61	0	0
15	-9	79999	471037	471670	-76391	3483	1691	7	3
15	-8	-56934	-37590	36077	-58152	-70	38	0	0
15	-7	-81443	-487526	487497	-81435	209	-420	0	-1
15	-6	-1544	-7792	7792	-1544	4	-4	0	0
15	-5	-31	-144	144	-31	0	0	0	0
15	-4	0	-3	3	0	0	0	0	0
15	15	1	0	0	-1	0	0	0	0
15	16	-1	0	0	1	0	0	0	0
15	17	12	33	33	-12	0	0	0	0
15	18	163	-236	-237	-163	-1	-7	0	0
16	-18	-38	-123	121	-34	0	3	0	0
16	-17	-40	58	-63	-31	0	0	0	0
16	-16	4	3	-2	5	0	0	0	0
16	-15	3	-6	3	-1	3	0	0	0
16	-14	-8	-5	50	9	-6	0	0	0
16	-13	-162	144	-84	-196	-24	-5	0	0
16	-12	430	36	-201	387	22	36	0	0
16	-11	-742	-419	701	206	17	-64	0	0
16	-10	-2143	-148	-1740	1484	-137	70	0	0
16	-9	2068	-344	1111	1672	-69	-38	0	0
16	-8	3911	1716	-1711	3914	17	32	0	0
16	-7	-5	-164	164	-5	-2	5	0	0
16	-6	0	-6	6	0	0	0	0	0
16	14	0	1	0	0	0	0	0	0
16	15	2	-1	0	-2	0	0	0	0
16	16	-2	0	0	0	0	0	0	0
16	17	14	41	41	-14	0	0	0	0
16	18	94	-159	-160	-94	-2	-7	0	0
17	-18	-27	-62	56	-39	0	2	0	0
17	-17	-16	14	-16	-15	0	0	0	0
17	-16	0	3	-4	0	-1	-2	0	0
17	-15	25	13	-23	15	0	6	0	0
17	-14	-7	-123	118	25	11	-10	0	0
17	-13	-182	185	-127	-231	-26	-3	0	0
17	-12	532	-115	-266	218	24	30	0	0
17	-11	4406	-3615	-2766	-4906	18	-66	0	0
17	-10	-67466	-27292	-28704	67107	885	-556	2	-1
17	-9	-16740	7729	-8120	-16606	-48	9	0	0
17	-8	63693	26668	-26664	63688	-57	-93	0	0
17	-7	1120	525	-525	1120	0	0	0	0
17	-6	22	10	-10	22	0	0	0	0
17	-5	-1	-1	-1	1	0	0	0	0
17	-4	0	3	3	0	0	0	0	0
17	-3	3	-2	-2	-3	0	0	0	0
17	-2	-2	0	0	0	0	0	0	0
17	17	12	20	20	-12	0	0	0	0
17	18	37	-37	-37	-36	-3	-4	0	0
18	-18	-12	-48	47	-16	-1	2	0	0
18	-17	-2	-17	18	-4	0	0	0	0
18	-16	-13	7	-15	-3	-3	0	0	0
18	-15	57	39	-50	45	0	9	0	0
18	-14	-19	-160	158	17	11	-12	0	0
18	-13	-152	189	-131	-207	-23	0	0	0
18	-12	363	-204	-271	236	22	23	0	0
18	-11	581	-788	-159	-1030	6	-76	0	0
18	-10	-325	938	-1016	-79	30	-21	0	0
18	-9	-1368	810	-813	-1368	-15	-1	0	0
18	-8	37	28	-28	37	-1	-1	0	0
18	-7	1	1	-1	1	0	0	0	0
18	-6	2	0	-2	2	0	0	0	0
18	-5	-2	-2	-2	2	0	0	0	0
18	-4	0	4	4	0	0	0	0	0
18	-3	3	-2	-2	-3	0	0	0	0
18	-2	-2	0	0	2	0	0	0	0
18	-1	5	17	17	-5	0	0	0	0
18	18	6	48	48	-6	-2	-2	0	0

Table A-3. (Cont.)

c) Mars on Earth

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-61	0	0	0	-13	0
0	1	0	0	23	21	0	0	5	4
0	2	-2	0	0	-2	-2	0	0	0
1	-3	0	-1	-1	0	-1	-1	0	0
1	-2	-11	-7	-10	10	-47	-38	-4	6
1	-1	-2145	-1638	-426	559	-2146	-1646	-91	118
1	0	-39	-448	117	-8	-75	-476	28	-5
1	1	8	-10	7	6	6	-18	2	1
2	-4	1	0	0	-1	9	-2	0	-1
2	-3	71	-6	-11	-72	396	-101	-12	-49
2	-2	19733	-5525	-2638	-9419	19453	-5626	-566	-1954
2	-1	-16762	-6008	249	-810	-16431	-6097	63	-136
2	0	36	258	-137	20	-238	155	-18	-25
2	1	1	1	-1	1	-5	3	0	-1
3	-5	0	0	0	0	0	-1	0	0
3	-4	-3	-17	-16	1	6	-37	-5	-1
3	-3	454	-1142	-710	-283	520	-1167	-152	-66
3	-2	3922	-1506	-372	-950	3930	-1524	-76	-199
3	-1	18	37	-11	-4	84	12	0	6
3	0	1	3	-2	1	2	3	0	0
4	-5	8	3	3	-7	10	9	1	-2
4	-4	128	235	174	-91	106	315	45	-17
4	-3	-1392	4829	2194	630	-1302	4789	457	124
4	-2	5233	-2624	244	461	5209	-2543	43	95
4	-1	-15	-14	-8	-9	73	-57	6	7
4	0	0	0	0	0	2	-1	0	0
5	-6	-4	3	3	4	-5	3	1	1
5	-5	-77	-4	-2	60	-69	8	1	12
5	-4	488	655	396	-294	481	688	87	-61
5	-3	-381	1982	417	76	-372	1993	87	17
5	-2	32	-26	13	16	26	8	-1	3
6	-7	0	-3	-3	0	0	-3	-1	0
6	-6	19	-22	-19	-15	15	-23	-4	-3
6	-5	-183	-4	-4	130	-200	-24	-3	29
6	-4	-1028	-1139	-489	443	-1032	-1122	-101	93
6	-3	-91	1013	-137	-9	-108	994	-27	-4
6	-2	0	2	-1	1	-2	19	-2	0
7	-8	1	1	1	-1	1	1	0	0
7	-7	3	11	10	-2	3	11	2	-1
7	-6	36	-51	-39	-28	28	-50	-8	-5
7	-5	-470	41	23	275	-482	28	4	59
7	-4	-769	-713	-123	136	-777	-712	-26	28
7	-3	2	20	-10	1	-11	8	-1	-1
8	-9	-1	0	0	1	-1	0	0	0
8	-8	-4	-2	-2	4	-4	-2	0	1
8	-7	8	26	21	-7	9	24	4	-1
8	-6	53	-83	-58	-38	62	-84	-12	-9
8	-5	511	-91	-38	-207	509	-95	-8	-43
8	-4	-176	-132	23	-32	-167	-133	5	-6
8	-3	-1	-1	0	0	-3	-3	0	0
9	-10	0	-1	-1	0	0	-1	0	0
9	-9	2	-1	-1	-2	2	-1	0	0
9	-8	-12	-4	-4	10	-11	-4	-1	2
9	-7	14	33	25	-11	16	29	5	-2
9	-6	123	-242	-137	-70	133	-244	-29	-16
9	-5	589	-160	-23	-81	591	-164	-4	-17
9	-4	-8	-4	2	-4	2	-7	1	0
10	-10	0	1	1	0	0	1	0	0
10	-9	5	-3	-3	-5	5	-3	-1	-1
10	-8	-16	-4	-4	13	-15	-4	-1	3
10	-7	21	44	30	-14	20	47	7	-3
10	-6	-70	174	66	26	-69	175	14	5
10	-5	50	-20	5	11	49	-17	1	2
10	-4	0	0	0	0	1	0	0	0
11	-10	0	3	3	0	0	3	1	0
11	-9	7	-5	-4	-6	4	-5	-1	-1
11	-8	-18	-3	-2	13	-16	0	0	3
11	-7	86	143	78	-47	84	150	17	-10
11	-6	-123	410	41	12	-122	413	8	3
11	-5	4	-2	1	2	2	5	0	0
12	-11	-1	-1	-1	1	-1	-1	0	0
12	-10	0	4	4	0	0	4	1	0
12	-9	6	-6	-5	-5	6	-6	-1	-1
12	-8	-24	-2	-2	16	-24	-4	0	3
12	-7	-42	-58	-20	15	-43	-57	-4	3
12	-6	-3	14	-4	-1	-3	13	-1	0
13	-12	1	0	0	-1	1	0	0	0
13	-11	-2	-1	-1	2	-2	-1	0	0
13	-10	0	5	4	0	0	4	1	0
13	-9	5	-6	-5	-4	3	-7	-1	-1
13	-8	-123	-2	-1	65	-128	-7	-1	14
13	-7	-294	-335	-19	18	-296	-335	-4	3
13	-6	0	3	-1	0	-5	-3	0	-1
14	-12	1	0	0	-1	1	0	0	0

Table A-3. (Cont.)

c) Mars on Earth

14	-11	-2	-1	-1	2	-2	-1	0	0
14	-10	1	4	3	-1	1	4	1	0
14	-9	7	-9	-6	-5	7	-9	-1	-1
14	-8	28	-2	-1	-9	28	-2	0	-2
14	-7	-3	-3	1	-1	-3	-3	0	0
15	-13	0	1	1	0	0	1	0	0
15	-12	1	-1	-1	-1	1	-1	0	0
15	-11	-2	-1	-1	2	-2	-1	0	0
15	-10	2	3	2	-1	4	0	0	-1
15	-9	101	-158	-80	-51	134	-163	-17	-14
15	-8	1976	-327	-6	-33	1978	-329	-1	-7
15	-7	-3	-2	1	-1	31	-7	1	3
15	-6	0	0	0	0	1	0	0	0
16	-13	0	1	1	0	0	1	0	0
16	-12	1	-1	-1	-1	1	-1	0	0
16	-11	-2	-1	-1	1	-2	-1	0	0
16	-10	2	5	3	-1	2	5	1	0
16	-9	-6	10	3	2	-5	11	1	0
16	-8	1	0	0	0	1	0	0	0
17	-13	0	1	1	0	0	1	0	0
17	-12	1	-1	0	-1	1	-1	0	0
17	-11	-2	-1	-1	1	-2	-1	0	0
17	-10	-22	-46	-23	11	-24	-42	-4	2
17	-9	-112	271	-7	-3	-113	270	-1	-1
17	-8	-1	0	0	0	-2	5	-1	0
18	-13	0	1	1	0	0	1	0	0
18	-12	1	-1	0	-1	1	-1	0	0
18	-11	-3	-1	0	2	-3	-1	0	0
18	-10	-3	-4	-1	1	-3	-4	0	0

Table A-3. (Cont.)

Secular Terms

c) Mars on Earth

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	3099153	0	-3223485	0	19627	0
1	25969	9011	9011	43298	-780096	989898
2	-1032470	1074344	-1074193	-1032325	-6541	8300
3	-25975	27024	-27022	-25973	-82	104
4	-581	604	-604	-581	-1	2
5	-13	13	-13	-13	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	86	0	21	0	24	0
1	-5154	-4956	2478	-2577	-935	1187
2	-22	-21	21	-22	-8	10

Table A-3. (Cont.)
Periodic Terms
d) Jupiter on Earth

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	74997	0	25389	0	-3821	0	-8	0	
0	1	-1185788	-1348	355	-1181547	0	0	0	0	
0	2	35311	25395	-25370	35316	-1012	800	-2	2	
0	3	764	354	-354	764	-9	12	0	0	
0	4	16	4	-4	16	0	0	0	0	
1	-6	0	-2	-2	0	0	0	0	0	
1	-5	31	-111	-111	-31	0	0	0	0	
1	-4	1179	-5114	-5113	-1179	-2	0	0	0	
1	-3	35711	-230586	-230570	-35706	-201	-58	0	0	
1	-2	-20399	-9341876	-9340507	20089	-22418	-732	-46	-2	
1	-1	6336056	-658023	-563520	-6776170	8966	-86758	18	-179	
1	0	445856	25648426	-25554083	238650	-71880	8519	-148	18	
1	1	-6021316	855751	-855998	-6020039	-20238	-107225	-42	-221	
1	2	-135916	-190	190	-135906	-227	-843	0	-2	
1	3	-2803	-106	106	-2803	-3	-11	0	0	
1	4	-58	-3	3	-58	0	0	0	0	
1	5	-1	0	0	-1	0	0	0	0	
2	-6	-39	6	6	39	0	0	0	0	
2	-5	-1628	205	205	1628	0	0	0	0	
2	-4	-63928	6107	6109	63923	0	-29	0	0	
2	-3	-1999048	86183	86561	1998725	-86	-2005	0	-4	
2	-2	-2041744	-780359	-716686	2042910	-3233	-7564	-7	-16	
2	-1	11339238	-643365	553058	10891894	-62693	-807250	-129	-1665	
2	0	5364505	1866482	-1864957	5358320	-8652	28271	-18	58	
2	1	-126925	60227	-60228	-126878	-1308	-3193	-3	-7	
2	2	-3280	812	-812	-3279	-14	-22	0	0	
2	3	-70	14	-14	-70	0	0	0	0	
2	4	-1	0	0	-1	0	0	0	0	
3	-7	0	-2	-2	0	0	0	0	0	
3	-6	-31	-84	-84	31	0	0	0	0	
3	-5	-895	-2902	-2901	896	4	0	0	0	
3	-4	-19130	-71784	-71805	19259	217	-16	0	0	
3	-3	-416892	57129	49570	427452	-294	-293	-1	-1	
3	-2	-239682	674707	-768891	355124	-29155	2069	-60	4	
3	-1	2247902	-290227	283925	2229600	-12816	-96420	-26	-199	
3	0	726102	103477	-103471	725865	-691	3867	-1	8	
3	1	1478	3721	-3721	1481	-84	-102	0	0	
3	2	-25	65	-64	-25	0	0	0	0	
3	3	0	1	-1	0	0	0	0	0	
4	-7	7	-4	-4	-7	0	0	0	0	
4	-6	223	-85	-85	-223	0	0	0	0	
4	-5	4592	-1290	-1324	-4602	3	28	0	0	
4	-4	-5905	-18927	-20772	4285	41	-37	0	0	
4	-3	-134948	22043	4495	-9411	-365	-2178	-1	-4	
4	-2	-5654	189088	-192433	63538	-8147	1304	-17	3	
4	-1	315830	-66133	65715	315099	-1672	-8983	-3	-19	
4	0	78362	2535	-2537	78352	-39	414	0	1	
4	1	689	184	-184	689	-5	-2	0	0	
4	2	9	4	-4	9	0	0	0	0	
5	-7	10	22	22	-10	0	0	0	0	
5	-6	127	379	382	-136	-4	0	0	0	
5	-5	1445	-587	-285	-1775	6	6	0	0	
5	-4	-2532	-12088	5171	-372	242	-50	0	0	
5	-3	-32226	6913	-2041	-16060	-161	-728	0	-2	
5	-2	3512	31989	-31703	11054	-1471	350	-3	1	
5	-1	38376	-11366	11340	38354	-178	-761	0	-2	
5	0	7897	-435	435	7897	0	40	0	0	
5	1	91	4	-4	91	0	0	0	0	
5	2	1	0	0	1	0	0	0	0	

Table A-3. (Cont.)
d) Jupiter on Earth

6	-8	-2	1	1	2	0	0	0	0
6	-7	-36	15	16	37	0	0	0	0
6	-6	78	132	192	-24	-1	1	0	0
6	-5	1469	-360	144	801	8	31	0	0
6	-4	-971	-4005	3034	-593	96	-24	0	0
6	-3	-5792	1635	-863	-3852	-43	-148	0	0
6	-2	926	4330	-4236	1740	-218	69	0	0
6	-1	4335	-1692	1690	4336	-17	-62	0	0
6	0	785	-105	105	785	0	4	0	0
6	1	10	0	0	10	0	0	0	0
7	-8	-2	-4	-4	2	0	0	0	0
7	-7	-13	11	2	24	0	0	0	0
7	-6	59	197	-119	31	-4	1	0	0
7	-5	603	-166	123	496	4	14	0	0
7	-4	-270	-884	764	-212	23	-7	0	0
7	-3	-860	310	-197	-635	-9	-23	0	0
7	-2	157	515	-498	248	-29	12	0	0
7	-1	474	-234	234	474	-1	-5	0	0
7	0	80	-17	17	80	0	0	0	0
7	1	1	0	0	1	0	0	0	0
8	-8	-2	-1	-3	0	0	0	0	0
8	-7	-28	10	-6	-18	0	0	0	0
8	-6	31	96	-82	24	-2	0	0	0
8	-5	155	-52	45	141	1	4	0	0
8	-4	-58	-153	139	-50	4	-2	0	0
8	-3	-112	50	-34	-86	-1	-3	0	0
8	-2	22	56	-53	33	-4	2	0	0
8	-1	52	-31	31	52	0	0	0	0
8	0	9	-2	2	9	0	0	0	0
8	10	1	-2	-2	-1	0	0	0	0
9	-10	-2	-1	1	-2	0	0	0	0
9	-9	-1	0	0	-2	0	0	0	0
9	-8	-2	-4	3	-1	0	0	0	0
9	-7	-16	6	-5	-14	0	0	0	0
9	-6	11	28	-26	10	0	0	0	0
9	-5	31	-13	11	29	0	0	0	0
9	-4	-10	-22	21	-9	0	0	0	0
9	-3	-13	7	-5	-10	0	0	0	0
9	-2	3	6	-5	4	0	0	0	0
9	-1	6	-4	4	6	0	0	0	0
9	0	1	0	0	1	0	0	0	0
9	10	4	0	0	-4	0	0	0	0
10	-10	-3	-4	4	-3	0	0	0	0
10	-9	1	0	0	1	0	0	0	0
10	-8	-1	-3	2	0	0	0	0	0
10	-7	-5	2	-2	-5	0	0	0	0
10	-6	3	6	-6	3	0	0	0	0
10	-5	5	-2	2	5	0	0	0	0
10	-4	-2	-3	3	-2	0	0	0	0
10	-3	-1	0	0	-1	0	0	0	0
10	9	1	1	1	-1	0	0	0	0
10	10	-2	0	0	2	0	0	0	0

Table A-3. (Cont.)
d) Jupiter on Earth

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))			
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-2439	0	0	0	-514	0
0	1	0	0	187	105	0	0	39	22
0	2	0	3	-1	1	0	3	0	0
1	-4	0	0	0	0	-1	0	0	0
1	-3	-3	-5	-5	4	-34	-13	-2	5
1	-2	-336	-525	-373	313	-1546	-517	-78	193
1	-1	-72063	995	457	33560	-72100	550	51	7069
1	0	-1861	-25956	1099	182	-3067	-25944	229	-89
1	1	128	-295	160	68	71	-730	79	8
1	2	1	-1	1	1	1	-15	2	0
2	-4	1	2	4	-1	3	16	2	-1
2	-3	84	223	257	-72	106	682	103	-18
2	-2	1417	27039	18988	-991	1328	27289	4024	-199
2	-1	-5421	14738	6773	2310	-5399	15176	1377	489
2	0	-133	-965	127	5	-224	-708	-1	-8
2	1	2	-10	6	1	-2	-20	2	0
3	-5	0	0	0	0	-1	1	0	0
3	-4	-22	13	13	27	-50	18	3	8
3	-3	-1634	175	157	1330	-1622	268	43	279
3	-2	739	5483	3772	-481	706	5520	797	-104
3	-1	-325	2003	870	118	-313	2094	173	26
3	0	-10	-48	11	0	-15	-13	-1	-1
4	-5	-2	-3	-4	2	-3	-6	-1	1
4	-4	-23	-158	-138	22	-30	-157	-29	5
4	-3	-433	76	60	350	-431	86	14	73
4	-2	173	778	524	-109	166	783	111	-24
4	-1	-12	218	88	2	-9	231	17	1
4	0	-1	-3	1	0	-1	1	0	0
5	-6	0	0	0	-1	1	0	0	0
5	-5	19	-4	-4	-17	18	-4	-1	-4
5	-4	-11	-53	-46	9	-12	-53	-10	2
5	-3	-73	19	14	58	-72	19	3	12
5	-2	30	95	63	-19	29	96	13	-4
5	-1	1	22	8	-1	1	24	2	0
6	-6	1	2	2	-1	1	2	0	0
6	-5	8	-2	-2	-7	8	-2	0	-1
6	-4	-3	-11	-9	3	-3	-11	-2	1
6	-3	-10	3	3	8	-10	3	1	2
6	-2	4	11	7	-3	4	11	1	-1
6	-1	0	2	1	0	0	2	0	0
7	-6	0	1	1	0	0	1	0	0
7	-5	2	-1	0	-2	2	-1	0	0
7	-4	-1	-2	-1	0	-1	-2	0	0
7	-3	-1	1	0	1	-1	1	0	0
7	-2	1	1	1	0	1	1	0	0

Table A-3. (Cont.)

Secular Terms

d) Jupiter on Earth

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	16303171	0	-23271172	0	542420	0
1	136707	65054	65054	227866	-21559226	553536
2	-5431333	7755966	-7754875	-5430569	-180773	4641
3	-136640	195095	-195082	-136631	-2274	58
4	-3055	4362	-4362	-3055	-34	0
5	-67	95	-95	-67	0	0
6	-1	2	-2	-1	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	624	0	109	0	650	0
1	-37209	-26069	13035	-18604	-25851	664
2	-156	-109	109	-156	-217	6
3	-1	-1	1	-2	-3	0

Table A-3. (Cont.)
Periodic Terms
e) Saturn on Earth

J	K	DX		DY (IN UNITS OF 10**(-12))		DZ		U/COS(I) (10**(-4) SECONDS OF ARC)	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	2785	0	132	0	42	0	0	0
0	1	-55924	-161	-152	-55237	0	0	0	0
0	2	921	133	-134	924	-12	8	0	0
0	3	65	26	-26	65	0	0	0	0
0	4	2	0	0	2	0	0	0	0
1	-5	-8	-2	-2	8	0	0	0	0
1	-4	-337	-75	-75	337	0	0	0	0
1	-3	-14376	-3054	-3054	14374	0	7	0	0
1	-2	-504790	-96530	-96528	504684	29	702	0	1
1	-1	816389	-3648	-10271	-802666	-218	-35071	0	-72
1	0	1505201	277919	-280301	1494182	-1415	4690	-3	10
1	1	-765564	9860	-9877	-765421	4831	-24558	10	-51
1	2	-14820	544	-544	-14819	40	-205	0	0
1	3	-289	15	-15	-289	0	-3	0	0
1	4	-6	0	0	-6	0	0	0	0
2	-6	1	0	0	-1	0	0	0	0
2	-5	57	21	21	-57	0	0	0	0
2	-4	2232	824	824	-2232	0	0	0	0
2	-3	70630	26632	26625	-70620	-17	63	0	0
2	-2	123392	55220	54514	-122413	-819	1432	-2	3
2	-1	-369835	-148074	158239	-449682	-89185	138567	-184	286
2	0	-350261	-156421	156305	-350615	2327	-3406	5	-7
2	1	-41251	-6516	6514	-41243	292	-1081	1	-2
2	2	-757	-90	90	-757	2	-9	0	0
2	3	-14	-1	1	-14	0	0	0	0
3	-6	2	0	0	-2	0	0	0	0
3	-5	63	34	34	-63	0	0	0	0
3	-4	1784	955	955	-1785	0	3	0	0
3	-3	14421	5305	5314	-14489	0	9	0	0
3	-2	5501	-574	15911	-33240	629	-607	1	-1
3	-1	-80459	-29785	31165	-85789	-11531	18227	-24	38
3	0	-53860	-21295	21290	-53876	320	-485	1	-1
3	1	-3018	-865	865	-3017	23	-65	0	0
3	2	-54	-14	14	-54	0	0	0	0
3	3	-1	0	0	-1	0	0	0	0
4	-6	2	2	2	-2	0	0	0	0
4	-5	59	46	46	-59	0	0	0	0
4	-4	439	243	248	-449	0	0	0	0
4	-3	1362	140	1338	-2755	39	-28	0	0
4	-2	-1731	-1494	3102	-6107	199	-210	0	0
4	-1	-11491	-4133	4275	-11885	-1164	1862	-2	4
4	0	-5926	-2177	2177	-5927	34	-52	0	0
4	1	-240	-87	87	-240	2	-4	0	0
4	2	-4	-1	1	-4	0	0	0	0
5	-6	2	3	3	-2	0	0	0	0
5	-5	18	14	15	-19	0	0	0	0
5	-4	37	-6	91	-117	3	-1	0	0
5	-3	0	-126	303	-502	14	-11	0	0
5	-2	-480	-330	481	-922	37	-40	0	0
5	-1	-1387	-489	502	-1418	-107	173	0	0
5	0	-582	-200	200	-582	3	-5	0	0
5	1	-20	-8	8	-20	0	0	0	0
6	-6	0	0	1	0	0	0	0	0
6	-5	1	-1	7	-6	0	0	0	0
6	-4	-6	-15	27	-28	1	0	0	0
6	-3	-27	-37	56	-83	3	-2	0	0
6	-2	-80	-51	65	-122	5	-6	0	0
6	-1	-153	-53	54	-155	-9	15	0	0
6	0	-54	-17	17	-54	0	0	0	0
6	1	-2	0	0	-2	0	0	0	0
7	-5	0	-2	3	-2	0	0	0	0
7	-4	-3	-5	6	-6	0	0	0	0
7	-3	-6	-7	9	-12	0	0	0	0
7	-2	-11	-7	8	-15	0	0	0	0
7	-1	-16	-5	6	-16	0	1	0	0
7	0	-5	-1	1	-5	0	0	0	0
8	-4	0	0	1	-1	0	0	0	0
8	-3	-1	-1	1	-2	0	0	0	0
8	-2	-1	0	0	-2	0	0	0	0
8	-1	-2	0	0	-2	0	0	0	0

Table A-3. (Cont.)
e) Saturn on Earth

J	K	NDZ ----- (IN UNITS OF 10**(-4)) -----		NU ----- (IN UNITS OF 10**(-4)) -----		D (LONG.) ----- (IN UNITS OF 10**(-4)) -----		D LOG(R) ----- (IN UNITS OF 10**(-9)) -----	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-115	0	0	0	-24	0
0	1	0	0	6	1	0	0	1	0
0	2	0	1	-1	0	0	1	0	0
1	-3	0	0	0	0	-1	2	0	0
1	-2	-13	43	36	10	-26	112	15	4
1	-1	-775	4163	2025	377	-775	4108	420	79
1	0	-22	-3318	73	3	-35	-3248	8	-1
1	1	-3	-16	8	-2	-4	-70	7	0
1	2	0	0	0	0	0	-1	0	0
2	-4	0	0	0	0	0	-1	0	0
2	-3	2	-7	-9	-3	9	-24	-4	-1
2	-2	371	-991	-712	-266	378	-1007	-152	-57
2	-1	428	-955	-468	-209	435	-974	-97	-43
2	0	17	-151	2	-1	24	-168	2	1
2	1	0	-1	0	0	0	-3	0	0
3	-4	0	0	0	0	1	-1	0	0
3	-3	19	-33	-28	-16	20	-36	-6	-4
3	-2	73	-201	-143	-53	75	-204	-30	-11
3	-1	58	-147	-71	-28	60	-150	-15	-6
3	0	2	-9	0	0	3	-12	0	0
4	-4	1	-2	-1	-1	1	-2	0	0
4	-3	5	-9	-8	-4	5	-10	-2	-1
4	-2	10	-28	-20	-7	10	-29	-4	-2
4	-1	6	-16	-8	-3	6	-17	-2	-1
4	0	0	-1	0	0	0	-1	0	0
5	-4	0	-1	-1	0	0	-1	0	0
5	-3	1	-2	-1	-1	1	-2	0	0
5	-2	1	-3	-2	-1	1	-3	-1	0
5	-1	1	-2	-1	0	1	-2	0	0

Table A-3. (Cont.)

Secular Terms

e) Saturn on Earth

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	86268	0	-624693	0	46514	0
1	723	1746	1746	1206	-1848763	-392717
2	-28740	208202	-208172	-28736	-15502	-3293
3	-723	5237	-5237	-723	-195	-41
4	-16	117	-117	-16	-3	0
5	0	3	-3	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	17	0	0	0	56	0
1	-999	-138	69	-499	-2217	-471
2	-4	-1	1	-4	-19	-4

Table A-3. (Cont.)
Periodic Terms
f) Uranus on Earth

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	63	0	-5	0	0	0	0	0	
0	1	-1039	0	0	-1038	0	0	0	0	
0	2	28	-5	5	28	0	0	0	-0	
1	-4	-2	8	8	2	0	0	0	0	
1	-3	-79	332	332	79	0	0	0	0	
1	-2	-3817	12488	12486	3817	3	0	0	0	
1	-1	36545	878	920	-36866	127	-204	0	0	
1	0	13762	-37043	36863	12478	10	13	0	0	
1	1	-36120	-1304	1304	-36114	-152	-332	0	-1	
1	2	-820	9	-9	-820	-1	-3	0	0	
1	3	-17	0	0	-17	0	0	0	0	
2	-4	-32	-32	-32	32	0	0	0	0	
2	-3	-1038	-979	-979	1038	0	0	0	0	
2	-2	-6524	-5129	-5142	6520	7	-22	0	0	
2	-1	6614	5291	-5248	4209	786	-2553	2	-5	
2	0	19286	15145	-15150	19242	-19	67	0	0	
2	1	-958	149	-149	-957	-5	-10	0	0	
2	2	-24	3	-3	-24	0	0	0	0	
3	-4	-17	0	0	17	0	0	0	0	
3	-3	-161	-161	-161	163	0	0	0	0	
3	-2	-583	-679	-566	843	3	0	0	0	
3	-1	937	896	-897	837	90	-278	0	-1	
3	0	2083	1818	-1818	2081	-2	7	0	0	
3	1	-25	21	-21	-25	0	0	0	0	
4	-4	-3	0	0	3	0	0	0	0	
4	-3	-18	-23	-15	18	0	0	0	0	
4	-2	-30	-69	-44	92	0	0	0	0	
4	-1	103	106	-106	98	8	-24	0	0	
4	0	178	163	-163	178	0	0	0	0	
4	1	0	2	-2	0	0	0	0	0	
5	-3	-2	-3	0	2	0	0	0	0	
5	-2	0	-6	-3	9	0	0	0	0	
5	-1	10	11	-11	10	0	-2	0	0	
5	0	14	13	-13	14	0	0	0	0	
6	0	1	1	-1	1	0	0	0	0	

		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	-2	0	0	0	0	0	
1	-2	1	0	0	-1	2	0	0	0	
1	-1	102	36	18	-50	102	34	4	-11	
1	0	3	-151	1	0	5	-150	0	0	
1	1	0	-2	1	0	0	-4	0	0	
2	-2	-13	13	10	9	-14	14	2	2	
2	-1	-42	53	26	21	-42	53	5	4	
2	0	0	-5	0	0	0	-4	0	0	
3	-2	-2	2	2	2	-2	2	0	0	
3	-1	-5	6	3	2	-5	6	1	1	

Table A-3. (Cont.)

Secular Terms

f) Uranus on Earth

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-3429	0	-18857	0	243	0
1	-29	53	53	-48	-9653	4950
2	1142	6285	-6284	1142	-81	42
3	29	158	-158	29	-1	0
4	0	4	-4	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	0	0	-0	0	0	0
1	-30	5	-3	-15	-12	6

Table A-3. (Cont.)
 Periodic Terms
 g) Neptune on Earth

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	122	0	-6120	0	167	0
1	1	17	17	2	-6647	-3808
2	-41	2040	-2040	-41	-56	-32
3	-1	51	-51	-1	0	0
4	0	1	-1	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	0	0	-0	0	0	0
1	-10	0	0	-5	-8	-5

Table A-3. (Cont.)
 Secular Terms
 g) Neptune on Earth

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	20	0	0	0	1	0	0	0		
0	1	-318	0	0	-317	0	0	0	0		
0	2	9	0	0	9	0	0	0	0		
1	-4	-1	-2	-2	1	0	0	0	0		
1	-3	-65	-107	-107	65	0	0	0	0		
1	-2	-2592	-4205	-4204	2591	0	0	0	0		
1	-1	3795	-337	-286	-3846	-19	-46	0	0		
1	0	7998	12498	-12538	7834	-5	3	0	0		
1	1	-3708	450	-450	-3707	31	-80	0	0		
1	2	-90	14	-14	-90	0	0	0	0		
1	3	-2	0	0	-2	0	0	0	0		
2	-4	-6	14	14	6	0	0	0	0		
2	-3	-203	450	450	203	0	0	0	0		
2	-2	-2109	4586	4589	2110	-18	-25	0	0		
2	-1	815	-2022	2116	1032	-2179	-2982	-4	-6		
2	0	6264	-13635	13635	6267	56	77	0	0		
2	1	177	-199	199	177	1	2	0	0		
2	2	3	-3	3	3	0	0	0	0		
3	-4	-3	0	0	3	0	0	0	0		
3	-3	-4	12	12	5	0	0	0	0		
3	-2	-9	90	98	64	0	0	0	0		
3	-1	21	-61	63	25	-45	-55	0	0		
3	0	109	-278	278	109	1	1	0	0		
3	1	3	-4	4	3	0	0	0	0		
4	-2	0	1	2	2	0	0	0	0		
4	-1	0	-1	1	0	0	0	0	0		
4	0	1	-4	4	1	0	0	0	0		

		NDZ		NU		D (LONG.)		D LOG(R)			
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	0	0	-1	0	0	0	0	0		
1	-2	0	0	0	0	-1	0	0	0		
1	-1	-34	22	11	17	-35	22	2	4		
1	0	-1	-16	0	0	-2	-16	0	0		
2	-2	5	2	2	-4	6	3	0	-1		
2	-1	37	17	9	-19	38	17	2	-4		
2	0	0	0	0	0	1	1	0	0		
3	-1	1	0	0	0	1	0	0	0		

Table A-4. Mars
Periodic Terms
a) Earth on Mars

		DX		DY		DZ		U/COS(11)	
		(IN UNITS OF 10**(-12))						(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-87550	0	-46185	0	85801	0	116	0
0	1	2453065	-4443	-21520	2330139	0	0	0	0
0	2	362182	-45620	43827	356523	-34806	13337	-47	18
0	3	26056	-5364	5188	25597	-5371	2479	-7	3
0	4	1866	-700	683	1823	-801	442	-1	1
0	5	132	-96	95	128	-122	79	0	0
0	6	8	-12	12	8	-19	14	0	0
0	7	0	-1	1	0	-3	3	0	0
1	-11	0	1	1	0	0	0	0	0
1	-10	4	10	10	-4	0	0	0	0
1	-9	36	86	86	-36	0	2	0	0
1	-8	303	731	731	-303	0	10	0	0
1	-7	2586	6296	6293	-2584	2	62	0	0
1	-6	22364	55082	55046	-22346	48	429	0	1
1	-5	197611	492813	492379	-197404	624	3295	1	4
1	-4	1802189	4569896	4563985	-1799533	7698	30760	10	42
1	-3	17105298	45022431	44923736	-17062968	120296	418831	163	567
1	-2	22538496	29574724	30203547	-23233887	-70569	-251463	-96	-340
1	-1	-19156788	-51735142	50345330	-18009400	-445068	-444695	-602	-602
1	0	-12119043	-18144282	18082944	-12069448	-12365	-13908	-17	-19
1	1	-1304220	-1938354	1933974	-1300555	12301	7606	17	10
1	2	-154972	-228150	227779	-154664	2043	1082	3	1
1	3	-18311	-26829	26795	-18285	337	151	0	0
1	4	-2168	-3174	3170	-2167	56	21	0	0
1	5	-257	-378	378	-257	9	3	0	0
1	6	-30	-45	45	-30	2	0	0	0
1	7	-3	-5	6	-4	0	0	0	0
2	-12	1	-3	-3	-1	0	0	0	0
2	-11	12	-28	-28	-12	0	0	0	0
2	-10	107	-236	-236	-107	3	-2	0	0
2	-9	934	-2035	-2034	-934	17	-11	0	0
2	-8	8292	-17808	-17796	-8288	104	-78	0	0
2	-7	75113	-159495	-159495	-75061	676	-590	1	-1
2	-6	704249	-1482442	-1480268	-703471	5092	-5067	7	-7
2	-5	7027425	-14675429	-14646122	-7014186	51025	-55663	69	-73
2	-4	13180185	-33973214	-33945118	-12938235	61461	-77	83	83
2	-3	-10465407	23803900	-11060957	-6808664	-218600	466201	-296	631
2	-2	-6152988	15548686	-15735927	-6217288	-724	-52507	-1	-71
2	-1	-526743	1077412	-1073896	-526072	562	-48911	1	-66
2	0	-62459	55400	-55156	-62420	-1035	-1097	-1	-10
2	1	-4657	5673	-5656	-4645	-125	-992	0	-1
2	2	-490	416	-416	-487	-30	-153	0	0
2	3	-55	25	-26	-55	-6	-24	0	0
2	4	-7	0	0	-7	-1	-4	0	0
2	5	-1	0	0	-1	0	0	0	0
3	-13	-6	1	1	6	0	0	0	0
3	-12	-49	9	9	49	-1	0	0	0
3	-11	-431	68	67	431	-6	-3	0	0
3	-10	-3815	567	3813	-60	-16	0	0	0
3	-9	-34393	4608	4601	34368	-264	-84	0	0
3	-8	-319440	40719	40650	319080	-1941	-478	-3	-1
3	-7	-3107115	382435	381624	3101152	-16999	-3278	-23	-4
3	-6	-12691019	2369609	2362810	12549539	37691	5957	51	8
3	-5	7835009	-1534288	-799221	-352389	219796	-21075	298	-29
3	-4	7375037	-1590005	751482	5256113	-87910	21687	-119	29
3	-3	5408	88355	-33659	119363	-24713	13159	-33	18
3	-2	-94002	42420	-43922	-96090	-16759	11929	-23	16
3	-1	-21719	8697	-8676	-21724	-1928	1504	-3	2
3	0	-3409	977	-969	-3408	-294	254	0	0
3	1	-441	173	-170	-440	-63	44	0	0
3	2	-59	25	-25	-59	-6	7	0	0
3	3	-8	4	-4	-8	0	1	0	0
3	4	-1	0	0	-1	0	0	0	0
4	-15	1	1	1	-1	0	0	0	0
4	-14	9	10	10	-9	0	0	0	0
4	-13	80	88	88	-80	0	2	0	0
4	-12	698	796	795	-698	2	14	0	0
4	-11	6212	7273	7269	-6207	21	86	0	0
4	-10	56987	67844	67770	-56920	179	565	0	1
4	-9	545156	654202	652922	-544108	1525	4059	2	5
4	-8	3613841	3947300	3912017	-3588750	-7470	-16643	-10	-23
4	-7	-2398358	-2394761	-915486	1257909	-54075	-71205	-73	-96
4	-6	-2652699	-2667036	1716645	-1369472	51277	54901	69	74
4	-5	-177194	-115407	-257468	431967	22130	18153	30	25
4	-4	119304	80091	-49334	53951	11136	5000	15	7
4	-3	19312	14758	-15493	21838	8862	2798	12	4
4	-2	5013	3434	-3449	4961	835	269	1	0
4	-1	694	492	-494	688	148	32	0	0
4	0	97	61	-62	95	24	4	0	0
4	1	15	8	-8	14	4	0	0	0
4	2	2	0	0	2	0	0	0	0
5	-16	1	-5	-5	-1	0	0	0	0
5	-15	11	-43	-43	-11	0	0	0	0
5	-14	108	-377	-377	-108	4	-3	0	0
5	-13	1025	-3392	-3390	-1024	20	-21	0	0
5	-12	9704	-31251	-31215	-9693	117	-134	0	0
5	-11	93618	-299043	-298472	-93423	472	-852	1	-1
5	-10	698032	-2502709	-2488798	-692551	-4910	7536	-7	10
5	-9	-352793	1681649	1161080	160140	-12917	34339	-17	46
5	-8	-471552	2011990	-1149488	-402184	14413	-50399	20	-68
5	-7	10514	143027	424438	5889	3602	-20170	5	-27
5	-6	19559	58821	206095	-5016	126	-11049	0	-15
5	-5	-3461	-43526	2155	6028	-1431	-5837	-2	-8
5	-4	806	-2144	4321	-75	-1477	-4190	-2	-6
5	-3	-128	-1580	1526	-77	-60	-274	0	0
5	-2	-4	-201	199	-2	-24	-55	0	0
5	-1	-4	-30	30	-3	-4	-9	0	0
5	0	-1	-5	5	-1	0	-1	0	0
6	-18	-2	0	0	2	0	0	0	0
6	-17	-22	7	7	22	0	0	0	0

Table A-4. (Cont.)

a) Earth on Mars

b	-16	-196	57	57	196	-2	0	0	0
c	-15	-1762	493	493	1760	-9	-2	0	0
d	-14	-16204	4451	4446	16184	-51	-9	0	0
e	-13	-155231	42566	42496	154965	-230	-36	0	0
f	-12	-1506237	443160	441826	1499991	4756	50	6	0
g	-11	-145827	-358314	-318455	-753935	15579	-3266	21	-4
h	-10	1278055	-421931	224869	897559	-34917	9732	-47	13
i	-9	39742	-36363	-136926	-233230	-11638	4379	-16	6
j	-8	54580	-53294	-94411	-138452	-6888	3671	-9	5
k	-7	26697	-28591	-43545	-53691	-4051	3173	-5	4
l	-6	-11251	11666	7957	4670	-1984	2480	-3	3
m	-5	604	-1174	-205	-363	-1219	1822	-2	2
n	-4	-383	419	-338	-364	-60	26	0	0
o	-3	-42	33	-32	-42	-12	22	0	0
p	-2	-6	7	-7	-6	-2	3	0	0
q	-1	0	1	-1	0	0	0	0	0
r	-20	2	2	2	-2	0	0	0	0
s	-19	15	13	13	-15	0	0	0	0
t	-18	131	117	117	-131	0	0	0	0
u	-17	1160	1046	1045	-1159	0	3	0	0
v	-16	10567	9556	9545	-10555	4	12	0	0
w	-15	101307	91487	91332	-101141	-9	6	0	0
x	-14	1076436	954974	952020	-1073371	-1577	-2550	-2	-3
y	-13	-596780	-448572	-384142	534932	-5637	-5649	-8	-8
z	-12	-982316	-841748	739587	-809087	21196	19536	29	26
aa	-11	-5286	1526	-72003	141568	5631	4439	8	6
ab	-10	-44311	-10597	-41678	94625	3969	2432	5	3
ac	-9	-46640	-10906	-20034	63085	3366	1477	5	2
ad	-8	-19466	-3304	-5906	25032	2583	619	3	1
ae	-7	447	7567	447	113	1739	40	2	0
af	-6	-1290	37	168	206	1099	-54	1	0
ag	-5	282	-4	-28	204	-19	30	0	0
ah	-4	14	5	-4	14	12	-2	0	0
ai	-3	4	0	0	3	1	0	0	0
aj	-23	0	-1	-1	0	0	0	0	0
ak	-22	2	-9	-9	-2	0	0	0	0
al	-21	14	-81	-81	-14	0	0	0	0
am	-20	119	-700	-700	-119	0	0	0	0
an	-19	1047	-6172	-6167	-1046	0	0	0	0
ao	-18	9502	-56022	-55960	-9491	-1	5	0	0
ap	-17	90611	-535866	-535060	-90471	-56	124	0	0
aq	-16	964010	-5772326	-5758915	-961649	-1696	3470	-2	5
ar	-15	-97231	1168368	1082407	75741	-1446	7464	-2	10
as	-14	-909391	5528137	-5445251	-911774	8600	-45273	12	-61
at	-13	-55577	207441	-130924	-64063	695	-5105	1	-7
au	-12	2217	36020	40440	-13093	32	-2594	0	-4
av	-11	9768	32144	40130	-11403	-250	-2221	0	-3
aw	-10	9764	24440	28083	-10423	-482	-1867	-1	-3
ax	-9	8893	8312	9452	-4065	-608	-1319	-1	-2
ay	-8	-2327	-3243	-3823	2609	-568	-786	-1	-1
az	-7	559	713	81	-242	-351	-430	0	-1
ba	-6	-114	-125	85	-46	40	16	0	0
bb	-5	2	-3	4	0	-5	-4	0	0
bc	-4	-1	-1	1	-1	0	0	0	0
bd	-24	-1	0	0	1	0	0	0	0
be	-23	-11	4	4	10	0	0	0	0
bf	-22	-91	39	39	91	0	0	0	0
bg	-21	-802	341	340	801	0	0	0	0
bh	-20	-7276	3080	3076	7268	-5	0	0	0
bi	-19	-69390	29249	29227	69292	-55	5	0	0
bj	-18	-739199	309536	308885	737471	-878	93	-1	0
bk	-17	-302022	156121	150778	286342	-958	479	-1	1
bl	-16	820845	-346978	314045	767643	12141	-4719	16	-6
bm	-15	189438	-95220	72798	160776	-798	449	-1	1
bn	-14	32073	-21368	4523	4500	-1013	627	-1	1
bo	-13	14718	-15559	-15416	-12846	-957	736	-1	1
bp	-12	11624	-15670	-16077	-12545	-858	839	-1	1
bq	-11	7373	-11830	-12353	-7874	-653	853	-1	1
br	-10	2043	-3533	-3414	-1988	-377	731	-1	1
bs	-9	-623	2121	2843	934	-162	523	0	1
bt	-8	144	-572	-236	-70	38	271	0	0
bu	-7	-15	109	-40	-23	-6	-38	0	0
bv	-6	-2	-3	0	0	0	5	0	0
bw	-24	4	3	3	-4	0	0	0	0
bx	-23	38	26	25	-38	0	0	0	0
by	-22	342	234	433	-341	0	1	0	0
bz	-21	3234	2232	2429	-3230	6	8	0	0
ca	-20	33350	23287	23438	-33280	73	93	0	0
cb	-19	51847	30683	29476	-50385	47	4	0	0
cc	-18	-51015	-33454	22461	-27150	-1734	-1292	-2	-2
cd	-17	-31364	-17077	11540	-16070	562	342	1	0
ce	-16	-9618	-3158	-1484	7274	528	267	1	0
cf	-15	-9645	-1579	-1408	10806	573	221	1	0
cg	-14	-11235	-830	-1095	12158	667	172	1	0
ch	-13	-10928	74	-38	11427	682	93	1	0
ci	-12	-7308	576	551	7388	622	-4	1	0
cj	-11	-1721	122	111	1438	468	-87	1	0
ck	-10	1164	-446	-482	-1573	291	-104	0	0
cl	-9	-343	152	131	154	130	-51	0	0
cm	-8	64	-38	-2	21	20	20	0	0
cn	-7	-2	3	0	0	-2	-3	0	0
co	-24	2	-63	-62	-2	0	0	0	0
cp	-23	21	-594	-590	-20	1	-2	0	0
cq	-22	247	-5944	-5930	-246	9	-24	0	0
cr	-21	-445	-18136	-17768	491	-14	22	0	0
cs	-20	304	13619	-992	-1160	-46	583	0	1
ct	-19	958	12257	-5166	-566	-2	-353	0	0
cu	-18	1061	3729	3774	-1267	-24	-280	0	0
cv	-17	1775	4157	4113	-1845	-54	-293	0	0
cw	-16	2733	5178	5066	-2867	-98	-333	0	0
cx	-15	3620	5683	5662	-3719	-153	-364	0	0
cy	-14	3765	4992	5092	-3804	-205	-355	0	0
cz	-13	2526	2925	2953	-2474	-229	-289	0	0
da	-12	395	545	554	-240	-187	-208	0	0
db	-11	-597	-374	-562	761	-146	-97	0	0
dc	-10	209	111	44	-152	-57	-38	0	0
dd	-9	-47	-18	9	0	20	4	0	0
de	-8	4	0	0	-3	0	0	0	0
df	-7	-1	-2	-2	1	0	0	0	0
dg	-24	-1168	682	677	1153	-9	2	0	0
dh	-23	-5688	3750	3699	5579	17	-3	0	0
di	-22	3907	-2772	-1240	-1109	166	-87	0	0
dj	-21	4166	-3111	-1849	-157	1859	99	0	0
dk	-20	1003	-1160	-1466	-1262	-105	78	0	0

Table A-4. (Cont.)

a) Earth on Mars

12	-19	1150	-1666	-1959	-1457	-104	94	0	0
12	-18	1427	-2457	-2842	-1599	-114	126	0	0
12	-17	1571	-3300	-3824	-1669	-123	169	0	0
12	-16	1447	-3817	-3882	-1492	-119	210	0	0
12	-15	1013	-3454	-3442	-1011	-94	231	0	0
12	-14	456	-1978	-1876	-419	-53	216	0	0
12	-13	109	-197	-33	-61	-13	165	0	0
12	-12	32	395	335	0	5	98	0	0
12	-11	-26	-147	-110	37	0	33	0	0
12	-10	10	33	0	-7	-5	-13	0	0
12	-9	-2	-3	0	0	1	2	0	0
12	23	-9	6	6	9	0	0	0	0
12	24	-77	52	52	77	-1	0	0	0
13	-24	-1698	-613	-513	1517	-23	-12	0	0
13	-23	-2082	-800	-659	-697	92	45	0	0
13	-22	-549	-62	-170	945	57	22	0	0
13	-21	-875	-34	-96	1103	62	16	0	0
13	-20	-1315	44	19	1438	79	15	0	0
13	-19	-1820	210	401	1900	104	9	0	0
13	-18	-2266	455	453	2315	131	-3	0	0
13	-17	-2396	687	986	2406	150	-21	0	0
13	-16	-1948	719	710	1909	149	-41	0	0
13	-15	-972	413	388	887	124	-55	0	0
13	-14	-51	-35	-73	-52	82	-53	0	0
13	-13	166	-145	-177	-240	43	-35	0	0
13	-12	-63	69	66	48	12	-9	0	0
13	-11	13	-19	-6	0	-5	8	0	0
13	-10	0	3	0	0	0	-2	0	0
13	-9	0	0	0	-1	0	0	0	0
13	-8	0	0	0	0	0	0	0	0
13	-7	0	0	0	0	0	0	0	0
13	-6	0	0	0	0	0	0	0	0
13	-5	0	0	0	0	0	0	0	0
13	-4	0	0	0	0	0	0	0	0
13	-3	0	0	0	0	0	0	0	0
13	-2	0	0	0	0	0	0	0	0
13	-1	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
13	1	0	0	0	0	0	0	0	0
13	2	0	0	0	0	0	0	0	0
13	3	0	0	0	0	0	0	0	0
13	4	0	0	0	0	0	0	0	0
13	5	0	0	0	0	0	0	0	0
13	6	0	0	0	0	0	0	0	0
13	7	0	0	0	0	0	0	0	0
13	8	0	0	0	0	0	0	0	0
13	9	0	0	0	0	0	0	0	0
13	10	0	0	0	0	0	0	0	0
13	11	0	0	0	0	0	0	0	0
13	12	0	0	0	0	0	0	0	0
13	13	0	0	0	0	0	0	0	0
13	14	0	0	0	0	0	0	0	0
13	15	0	0	0	0	0	0	0	0
13	16	0	0	0	0	0	0	0	0
13	17	0	0	0	0	0	0	0	0
13	18	0	0	0	0	0	0	0	0
13	19	0	0	0	0	0	0	0	0
13	20	0	0	0	0	0	0	0	0
13	21	0	0	0	0	0	0	0	0
13	22	0	0	0	0	0	0	0	0
13	23	0	0	0	0	0	0	0	0
13	24	0	0	0	0	0	0	0	0
14	-24	150	387	447	-118	4	19	0	0
14	-23	304	694	69	-105	-7	-26	0	0
14	-22	346	542	495	-355	-13	-34	0	0
14	-21	546	688	710	-559	-23	-45	0	0
14	-20	824	872	893	-837	-36	-57	0	0
14	-19	1100	984	993	-1106	-53	-66	0	0
14	-18	1216	925	918	-1208	-68	-78	0	0
14	-17	1002	656	630	-972	-78	-58	0	0
14	-16	463	281	243	-412	-73	-39	0	0
14	-15	-46	20	104	-55	-55	-20	0	0
14	-14	-118	-27	-49	155	-30	-7	0	0
14	-13	58	5	0	-56	-6	-3	0	0
14	-12	-16	0	3	-5	0	0	0	0
14	-11	2	-1	0	0	-1	0	0	0
14	-10	0	0	0	0	0	0	0	0
14	-9	0	0	0	0	0	0	0	0
14	-8	0	0	0	0	0	0	0	0
14	-7	0	0	0	0	0	0	0	0
14	-6	0	0	0	0	0	0	0	0
14	-5	0	0	0	0	0	0	0	0
14	-4	0	0	0	0	0	0	0	0
14	-3	0	0	0	0	0	0	0	0
14	-2	0	0	0	0	0	0	0	0
14	-1	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0	0
14	2	0	0	0	0	0	0	0	0
14	3	0	0	0	0	0	0	0	0
14	4	0	0	0	0	0	0	0	0
14	5	0	0	0	0	0	0	0	0
14	6	0	0	0	0	0	0	0	0
14	7	0	0	0	0	0	0	0	0
14	8	0	0	0	0	0	0	0	0
14	9	0	0	0	0	0	0	0	0
14	10	0	0	0	0	0	0	0	0
14	11	0	0	0	0	0	0	0	0
14	12	0	0	0	0	0	0	0	0
14	13	0	0	0	0	0	0	0	0
14	14	0	0	0	0	0	0	0	0
14	15	0	0	0	0	0	0	0	0
14	16	0	0	0	0	0	0	0	0
14	17	0	0	0	0	0	0	0	0
14	18	0	0	0	0	0	0	0	0
14	19	0	0	0	0	0	0	0	0
14	20	0	0	0	0	0	0	0	0
14	21	0	0	0	0	0	0	0	0
14	22	0	0	0	0	0	0	0	0
14	23	0	0	0	0	0	0	0	0
14	24	0	0	0	0	0	0	0	0
15	-24	194	-365	-165	-54	16	-22	0	0
15	-23	350	-749	-22	74	-11	18	0	0
15	-22	178	-619	-527	-124	-14	30	0	0
15	-21	138	-788	-782	-133	-15	42	0	0
15	-20	83	-945	-941	-82	-13	54	0	0
15	-19	9	-939	-923	-7	-7	62	0	0
15	-18	-39	-687	-655	0	0	61	0	0
15	-17	-19	-271	-228	19	8	50	0	0
15	-16	33	40	82	-35	10	33	0	0
15	-15	26	59	82	-27	6	16	0	0
15	-14	-19	-31	-30	21	0	2	0	0
15	-13	7	8	3	-5	-2	-3	0	0
15	-12	-2	0	0	0	0	0	0	0
15	-11	0	0	0	0	0	0	0	0
15	-10	0	0	0	0	0	0	0	0
15	-9	0	0	0	0	0	0	0	0
15	-8	0	0	0	0	0	0	0	0
15	-7	0	0	0	0	0	0	0	0
15	-6	0	0	0	0	0	0	0	0
15	-5	0	0	0	0	0	0	0	0
15	-4	0	0	0	0	0	0	0	0
15	-3	0	0	0	0	0	0	0	0
15	-2	0	0	0	0	0	0	0	0
15	-1	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
15	1	0	0	0	0	0	0	0	0
15	2	0	0	0	0	0	0	0	0
15	3	0	0	0	0	0	0	0	0
15	4	0	0	0	0	0	0	0	0
15	5	0	0	0	0	0	0	0	0
15	6	0	0	0	0	0	0	0	0
15	7	0	0	0	0	0	0	0	0
15	8	0	0	0	0	0	0	0	0
15	9	0	0	0	0	0	0	0	0
15	10	0	0	0	0	0	0	0	0
15	11	0	0	0	0	0	0	0	0
15	12	0	0	0	0	0	0	0	0
15	13	0	0	0	0	0	0	0	0
15	14	0	0	0	0	0	0	0	0
15	15	0	0	0	0	0	0	0	0
15	16	0	0	0	0	0	0	0	0
15	17	0	0	0	0	0	0	0	0
15	18	0	0	0	0	0	0	0	0
15	19	0	0	0	0	0	0	0	0
15	20	0	0	0	0	0	0	0	0
15	21	0	0	0	0	0	0	0	0
15	22	0	0	0	0	0	0	0	0
15	23	0	0	0	0	0	0	0	0
15	24	0	0	0	0	0	0	0	0
16	-24	-511	116	61	7				

Table A-4. (Cont.)

a) Earth on Mars

17	-7	0	0	-1	0	0	0	0	0
17	21	-2	-1	-1	2	0	0	0	0
17	22	-21	-17	-16	21	0	0	0	0
17	23	-207	-163	-161	206	0	0	0	0
17	24	-1966	-1436	-1422	1953	15	17	0	0
18	-24	-59	-798	438	39	-3	-50	0	0
18	-23	-173	-1307	820	-40	2	13	0	0
18	-22	-86	-350	-47	55	5	16	0	0
18	-21	-48	-134	-87	42	6	14	0	0
18	-20	-6	-128	-13	2	6	10	0	0
18	-19	16	15	24	-20	4	6	0	0
18	-18	5	6	9	-6	2	2	0	0
18	-17	-8	-5	-8	7	0	0	0	0
18	-16	2	2	0	-2	0	0	0	0
18	-15	-2	1	0	0	0	0	0	0
18	-14	-1	1	2	1	0	0	0	0
18	-13	0	0	3	2	0	0	0	0
18	-12	0	0	4	3	0	0	0	0
18	-11	1	-1	4	2	0	0	0	0
18	-10	1	-2	3	2	0	0	0	0
18	-9	0	-1	2	1	0	0	0	0
18	-8	0	-1	2	0	0	0	0	0
18	-7	0	0	1	0	0	0	0	0
18	-6	0	2	2	0	0	0	0	0
18	-5	2	35	34	-3	0	0	0	0
18	-4	21	346	342	-22	0	-1	0	0
18	-3	299	2975	2949	-299	3	-29	0	0
19	-24	-588	585	-461	-326	-31	36	0	0
19	-23	-791	885	-672	-645	5	-7	0	0
19	-22	-136	166	-55	-67	5	-9	0	0
19	-21	-20	19	-13	-8	3	-7	0	0
19	-20	0	-13	-21	-6	1	-4	0	0
19	-19	0	-3	-4	-2	0	-1	0	0
19	-18	0	0	0	0	0	0	0	0
19	-17	1	-2	-2	0	0	0	0	0
19	-16	3	0	0	-2	0	0	0	0
19	-15	2	0	0	-4	0	0	0	0
19	-14	0	0	0	-6	0	0	0	0
19	-13	-2	0	0	-6	0	0	0	0
19	-12	-2	0	0	-6	0	0	0	0
19	-11	-3	0	0	-5	0	0	0	0
19	-10	-2	0	0	-3	0	0	0	0
19	-9	-1	0	0	-2	0	0	0	0
19	-8	0	0	0	-1	0	0	0	0
19	-7	0	0	0	0	0	0	0	0
19	-6	-1	0	0	2	0	0	0	0
19	-5	0	-1	0	1	0	0	0	0
19	-4	26	-26	-25	-24	0	0	0	0
19	-3	268	-267	-263	-262	-1	0	0	0
19	-2	2024	-2196	-2174	-1998	-26	20	0	0
20	-24	708	59	-63	483	34	-1	0	0
20	-23	837	20	-24	764	-4	0	0	0
20	-22	113	5	0	112	0	1	0	0
20	-21	5	5	4	25	-2	0	0	0
20	-20	0	1	0	3	0	0	0	0
20	-19	2	-1	-2	-3	0	0	0	0
20	-18	-2	-1	0	1	0	0	0	0
20	-17	-2	-4	-2	2	0	0	0	0
20	-16	-1	-2	-4	3	0	0	0	0
20	-15	0	0	-6	5	0	0	0	0
20	-14	1	2	-7	5	0	0	0	0
20	-13	2	3	-6	5	0	0	0	0
20	-12	2	3	-4	4	0	0	0	0
20	-11	2	2	-3	3	0	0	0	0
20	-10	1	1	-1	2	0	0	0	0
20	-9	0	0	0	1	0	0	0	0
20	-8	2	0	1	-2	0	0	0	0
20	-7	3	1	2	-4	0	0	0	0
20	-6	1	0	2	-4	0	0	0	0
20	-5	-31	-2	0	26	0	0	0	0
20	-4	-327	-24	-21	316	1	0	0	0
20	-3	-2270	-61	-56	2234	30	4	0	0
21	-24	-273	-384	523	-227	-14	-14	0	0
21	-23	-294	-324	523	-258	1	0	0	0
21	-22	-30	-42	48	-41	0	0	0	0
21	-21	-3	-6	6	-5	0	0	0	0
21	-20	-2	0	0	0	0	0	0	0
21	-19	-1	4	1	-1	0	0	0	0
21	-18	-3	5	4	0	0	0	0	0
21	-17	0	3	0	8	0	0	0	0
21	-16	0	0	10	3	0	0	0	0
21	-15	2	-3	11	3	0	0	0	0
21	-14	2	-4	9	2	0	0	0	0
21	-13	0	-4	7	0	0	0	0	0
21	-12	0	-3	5	0	0	0	0	0
21	-11	0	-2	3	0	0	0	0	0
21	-10	0	-1	2	0	0	0	0	0
21	-9	0	-2	-2	0	0	0	0	0
21	-8	0	-3	-4	1	0	0	0	0
21	-7	-2	-4	-6	2	0	0	0	0
21	-6	-2	-3	-8	3	0	0	0	0
21	-5	11	15	8	-8	0	0	0	0
21	-4	124	170	159	-118	-14	-19	0	0
21	-3	727	919	892	-710	-14	-19	0	0
22	-24	-61	202	-198	-57	0	8	0	0
22	-23	-32	95	-102	-29	0	0	0	0
22	-22	-6	13	-13	-4	0	0	0	0
22	-21	1	2	-1	0	0	0	0	0
22	-20	6	-1	-2	-1	0	0	0	0
22	-19	7	-1	-3	-3	0	0	0	0
22	-18	3	-1	-4	-11	0	0	0	0
22	-17	0	0	-5	-14	0	0	0	0
22	-16	-5	1	-5	-14	0	0	0	0
22	-15	-6	2	-5	-11	0	0	0	0
22	-14	-5	2	-4	-8	0	0	0	0
22	-13	-3	2	-3	-5	0	0	0	0
22	-12	-2	1	-2	-3	0	0	0	0
22	-11	-1	0	-1	-1	0	0	0	0
22	-10	0	1	1	0	0	0	0	0
22	-9	-1	2	3	2	0	0	0	0
22	-8	-2	3	5	3	0	0	0	0
22	-7	-2	4	7	4	0	0	0	0
22	-6	-1	4	9	4	0	0	0	0
22	-5	3	-7	1	2	0	0	0	0
22	-4	26	-84	-72	-21	0	0	0	0
22	-3	89	-280	-261	-79	-2	14	0	0

Table A-4. (Cont.)

a) Earth on Mars

23 -24	41	-13	20	44	1	-1	0	0
23 -23	-10	19	-16	-12	0	0	0	0
23 -22	-4	0	-2	-2	0	0	0	0
23 -21	-6	-6	0	3	0	0	0	0
23 -20	-6	-6	-5	9	0	0	0	0
23 -19	-3	-1	-10	14	0	0	0	0
23 -18	2	3	-11	17	0	0	0	0
23 -17	6	5	-10	16	0	0	0	0
23 -16	7	5	-7	14	0	0	0	0
23 -15	6	3	-4	10	0	0	0	0
23 -14	4	2	-2	6	0	0	0	0
23 -13	3	0	-1	4	0	0	0	0
23 -12	1	0	0	2	0	0	0	0
23 -16	1	0	0	-1	0	0	0	0
23 -17	2	0	0	-3	0	0	0	0
23 -18	3	0	0	-4	0	0	0	0
23 -19	3	0	0	-6	0	0	0	0
23 -20	3	-1	-2	-8	0	0	0	0
23 -21	2	-1	-2	-9	0	0	0	0
23 -22	-2	0	-2	-6	0	0	0	0
23 -23	-15	4	0	7	0	0	0	0
23 -24	31	-47	-50	-39	5	-3	0	0
24 -24	7	4	-7	4	0	0	0	0
24 -23	14	7	0	13	0	0	0	0
24 -22	0	13	6	0	0	0	0	0
24 -21	0	11	15	0	0	0	0	0
24 -20	1	2	24	0	0	0	0	0
24 -19	2	-7	27	0	0	0	0	0
24 -18	0	-11	25	-2	0	0	0	0
24 -17	0	-11	19	-3	0	0	0	0
24 -16	-1	-8	13	-3	0	0	0	0
24 -15	-1	-5	7	-2	0	0	0	0
24 -14	0	-3	4	-1	0	0	0	0
24 -13	0	-2	2	0	0	0	0	0
24 -15	0	0	-1	0	0	0	0	0
24 -16	0	-1	-2	1	0	0	0	0
24 -17	-2	-1	-3	2	0	0	0	0
24 -18	-2	-2	-3	3	0	0	0	0
24 -19	-2	-1	-4	4	0	0	0	0
24 -20	-1	0	-4	5	0	0	0	0
24 -21	0	0	-3	4	0	0	0	0
24 -22	1	0	-2	3	0	0	0	0
24 -23	-2	-1	-3	5	0	0	0	0
24 -24	-41	-4	-5	42	-2	0	0	0

Table A-4. (Cont.)

a) Earth on Mars

NDZ								NU							
IN UNITS OF 10** (-4) SECONDS OF ARC															
J	K	COS	SIN	J	K	COS	SIN	J	K	COS	SIN	J	K	COS	SIN
0	0	0	0					0	0	3287	0				
0	1	2	10					0	1	682	-125				
0	2	-22	-118					0	2	136	-31				
0	3	-2	-10					0	3	16	-4				
0	4	0	-1					0	4	2	-1				
1	-7	0	0	2	-7	-1	0	1	-7	0	0	2	-7	-1	1
1	-6	0	0	2	-6	-8	-3	1	-6	0	-1	2	-6	-8	13
1	-5	4	-2	2	-5	-157	-50	1	-5	-3	-7	2	-5	-63	138
1	-4	54	-32	2	-4	-38139	-19169	1	-4	-35	-68	2	-4	-2880	5538
1	-3	1434	-934	2	-3	-65770	-25235	1	-3	-545	-898	2	-3	10134	-26257
1	-2	125669	-44745	2	-2	7941	2074	1	-2	-3342	-9941	2	-2	-1444	5613
1	-1	58382	-45095	2	-1	226	17	1	-1	16618	21419	2	-1	-79	260
1	0	413	-246	2	0	12	6	1	0	579	850	2	0	-5	28
1	1	34	-19	2	1	1	0	1	1	29	51	2	1	0	3
1	2	1	0	2	2	0	0	1	2	1	3	2	2	0	0
3	-10	0	0	4	-10	0	0	3	-10	0	0	4	-10	-1	-1
3	-9	0	0	4	-9	6	-7	3	-9	1	0	4	-9	-8	-11
3	-8	0	2	4	-8	1281	-954	3	-8	4	0	4	-8	-276	-380
3	-7	10	31	4	-7	8497	-7862	3	-7	41	-5	4	-7	2241	2448
3	-6	639	7292	4	-6	-2416	2683	3	-6	1611	-120	4	-6	-1828	-1630
3	-5	4960	25901	4	-5	-766	1001	3	-5	-8928	1676	4	-5	-928	-706
3	-4	-1656	-5648	4	-4	-299	477	3	-4	3976	-1187	4	-4	-483	-307
3	-3	-682	-1779	4	-3	5	-19	3	-3	1638	-622	4	-3	2	-6
3	-2	3	-14	4	-2	-1	1	3	-2	61	-16	4	-2	-2	-1
3	-1	-1	-4	4	-1	0	0	3	-1	7	-3	4	-1	0	0
3	0	0	0	4	0	0	0	3	0	1	0	4	0	0	0
5	-13	0	0	6	-13	0	1	5	-13	0	0	6	-13	2	0
5	-12	0	0	6	-12	20	122	5	-12	0	0	6	-12	53	-8
5	-11	-3	-1	6	-11	1097	3654	5	-11	-2	5	6	-11	-595	173
5	-10	-382	-153	6	-10	-542	-1359	5	-10	-57	139	6	-10	822	-331
5	-9	-5749	-1568	6	-9	-155	-316	5	-9	363	-1297	6	-9	284	-141
5	-8	2179	391	6	-8	-117	-192	5	-8	-246	1405	6	-8	199	-123
5	-7	681	68	6	-7	-100	-135	5	-7	-59	624	6	-7	147	-110
5	-6	408	3	6	-6	-55	-62	5	-6	-2	422	6	-6	69	-60
5	-5	204	-17	6	-5	10	7	5	-5	17	218	6	-5	-5	8
5	-4	-17	6	6	-4	-1	0	5	-4	-5	-9	6	-4	0	0
5	-3	1	0	6	-3	0	0	5	-3	0	1	6	-3	0	0
7	-17	0	0	8	-17	-1	0	7	-17	0	0	8	-17	0	1
7	-16	0	0	8	-16	-36	-12	7	-16	0	0	8	-16	-6	18
7	-15	1	0	8	-15	-15483	-2560	7	-15	-1	-1	8	-15	75	-425
7	-14	36	-31	8	-14	1965	148	7	-14	-15	-17	8	-14	-76	1018
7	-13	2437	-2771	8	-13	121	3	7	-13	264	237	8	-13	-3	110
7	-12	-695	946	8	-12	55	-5	7	-12	-533	-390	8	-12	5	57
7	-11	-98	155	8	-11	49	-9	7	-11	-138	-86	8	-11	11	55
7	-10	-51	100	8	-10	47	-13	7	-10	-105	-52	8	-10	15	54
7	-9	-36	91	8	-9	36	-13	7	-9	-101	-39	8	-9	15	41
7	-8	-22	75	8	-8	14	-6	7	-8	-84	-25	8	-8	7	16
7	-7	-7	35	8	-7	-4	3	7	-7	-39	-9	8	-7	-3	-3
7	-6	0	-8	8	-6	0	0	7	-6	7	0	8	-6	0	0
7	-5	0	1	8	-5	0	0	7	-5	0	0	8	-5	0	0
9	-19	0	0	10	-19	64	-90	9	-19	0	0	10	-19	-10	-7
9	-18	-1	-5	10	-18	58	-98	9	-18	-3	1	10	-18	42	24
9	-17	844	2036	10	-17	-7	14	9	-17	88	-36	10	-17	-11	-5
9	-16	282	537	10	-16	-4	10	9	-16	-253	133	10	-16	-10	-4
9	-15	-13	-19	10	-15	-3	11	9	-15	13	-10	10	-15	-12	-3
9	-14	-14	-19	10	-14	-2	12	9	-14	19	-15	10	-14	-15	-3
9	-13	-16	-18	10	-13	-1	14	9	-13	19	-18	10	-13	-17	-2
9	-12	-19	-18	10	-12	0	14	9	-12	20	-22	10	-12	-17	0
9	-11	-20	-16	10	-11	1	10	9	-11	18	-24	10	-11	-12	1
9	-10	-16	-11	10	-10	0	3	9	-10	12	-19	10	-10	-3	0
9	-9	-6	-3	10	-9	-1	-2	9	-9	4	-7	10	-9	2	-1
9	-8	3	1	10	-8	0	0	9	-8	-1	3	10	-8	0	0

Table A-4. (Cont.)

a) Earth on Mars

11	-23	0	0	12	-23	1	3	11	-23	0	0	12	-23	1	0
11	-22	0	0	12	-22	8	12	11	-22	0	0	12	-22	-4	2
11	-21	-15	-1	12	-21	-3	-4	11	-21	0	3	12	-21	2	-2
11	-20	-36	1	12	-20	-2	-2	11	-20	0	-13	12	-20	2	-2
11	-19	8	-1	12	-19	-2	-1	11	-19	1	6	12	-19	2	-2
11	-18	5	-1	12	-18	-2	-2	11	-18	1	5	12	-18	2	-3
11	-17	5	-1	12	-17	-3	-2	11	-17	2	5	12	-17	2	-4
11	-16	6	-2	12	-16	-4	-2	11	-16	3	6	12	-16	2	-5
11	-15	7	-3	12	-15	-5	-2	11	-15	4	8	12	-15	2	-6
11	-14	7	-4	12	-14	-4	-1	11	-14	5	9	12	-14	2	-5
11	-13	7	-5	12	-13	-3	-1	11	-13	6	8	12	-13	1	-3
11	-12	4	-3	12	-12	0	0	11	-12	4	5	12	-12	0	0
11	-11	1	-1	12	-11	1	0	11	-11	1	1	12	-11	0	1
11	-10	-1	1	12	-10	0	0	11	-10	-1	-1	12	-10	0	0
13	-24	1	-2	14	-24	0	0	13	-24	-2	-1	14	-24	0	0
13	-23	-1	3	14	-23	0	0	13	-23	-2	-1	14	-23	0	0
13	-22	0	1	14	-22	0	0	13	-22	-1	0	14	-22	0	1
13	-21	0	1	14	-21	1	0	13	-21	-1	0	14	-21	0	1
13	-20	0	1	14	-20	1	-1	13	-20	-1	0	14	-20	1	1
13	-19	0	2	14	-19	1	-1	13	-19	-2	0	14	-19	1	1
13	-18	0	2	14	-18	1	-1	13	-18	-3	0	14	-18	2	1
13	-17	0	3	14	-17	1	-1	13	-17	-3	1	14	-17	2	1
13	-16	1	3	14	-16	1	-1	13	-16	-4	1	14	-16	2	1
13	-15	1	3	14	-15	0	-1	13	-15	-3	1	14	-15	1	0
13	-14	1	1	14	-14	0	0	13	-14	-2	1	14	-14	0	0
13	25	1	-3	14	25	-1	0	13	25	3	1	14	25	0	-1
15	-24	1	0	16	-24	0	-1	15	-24	0	0	16	-24	-1	0
15	-23	0	0	16	-23	0	0	15	-23	0	0	16	-23	-1	0
15	-22	0	0	16	-22	0	0	15	-22	0	-1	16	-22	-1	0
15	-21	-1	0	16	-21	0	1	15	-21	0	-1	16	-21	-1	0
15	-20	-1	0	16	-20	0	1	15	-20	0	-1	16	-20	-1	0
15	-19	-1	0	16	-19	0	1	15	-19	0	-1	16	-19	-1	1
15	-18	-1	0	16	-18	0	0	15	-18	0	-1	16	-18	0	0
15	-17	-1	0	16	-17	0	0	15	-17	0	-1	16	-17	0	0
15	25	1	1	16	25	0	-2	15	25	-1	1	16	25	2	0
17	-25	0	0	18	-25	1	0	17	-25	0	0	18	-25	0	-1
17	-24	-1	1	18	-24	1	0	17	-24	1	1	18	-24	0	-1
17	-23	0	0	18	-23	0	0	17	-23	1	0	18	-23	0	-1
17	-21	0	0	18	-21	0	0	17	-21	1	0	18	-21	0	0
17	-20	0	0	18	-20	0	0	17	-20	1	0	18	-20	0	0
17	25	-2	3	18	25	4	0	17	25	-3	-2	18	25	0	4
19	-25	-1	-1	20	-25	0	1	19	-25	-1	1	20	-25	1	0
19	-24	-1	-1	20	-24	0	1	19	-24	-1	1	20	-24	1	0
19	25	-3	-3	20	25	0	3	19	25	3	-3	20	25	-3	0
21	-25	1	0	22	-25	0	0	21	-25	0	-1	22	-25	0	0
21	25	1	-1	22	25	0	0	21	25	1	1	22	25	0	0

Table A-4. (Cont.)

a) Earth on Mars

D (LONG)				D LOG (R)			
IN UNITS OF 10** (-4) SECOND OF ARC				(IN UNITS OF 10** (-9))			
J	K	COS	SIN	J	K	COS	SIN
0	0	0	0	0	0	692	0
0	1	0	-2	0	1	142	-26
0	2	-22	-118	0	2	29	-6
0	3	-4	-21	0	3	4	-1
0	4	-1	-3	0	4	1	0
1	-9	0	0	2	-9	-1	0
1	-8	0	0	2	-8	-8	-4
1	-7	3	-1	2	-7	-63	-9
1	-6	25	-10	2	-6	-521	-33
1	-5	198	-81	2	-5	-4413	-235
1	-4	1627	-664	2	-4	-21502	-850
1	-3	13781	-5595	2	-3	-68583	-2342
1	-2	131247	-49037	2	-2	1421	-31
1	-1	70144	-49297	2	-1	204	1
1	0	7219	-4935	2	0	27	6
1	1	871	-590	2	1	4	1
1	2	106	-71	2	2	1	0
1	3	13	-9	2	3	0	0
1	4	2	-1	2	4	0	0
3	-11	0	0	4	-11	3	0
3	-10	0	2	4	-10	25	-4
3	-9	2	14	4	-9	214	-26
3	-8	15	116	4	-8	2046	-131
3	-7	121	983	4	-7	8383	-559
3	-6	1084	9644	4	-6	-1685	-250
3	-5	4857	26035	4	-5	-926	-158
3	-4	-1251	-3321	4	-4	-365	-74
3	-3	-761	-2016	4	-3	-33	-5
3	-2	-72	-206	4	-2	-5	-1
3	-1	-10	-28	4	-1	-1	0
3	0	-1	-4	4	0	0	0
5	-15	0	0	6	-15	0	0
5	-14	0	0	6	-14	2	0
5	-13	-1	0	6	-13	13	-2
5	-12	-12	-4	6	-12	117	-12
5	-11	-98	-31	6	-11	1046	-42
5	-10	-893	-295	6	-10	-456	-57
5	-9	-5573	-1546	6	-9	-205	-32
5	-8	1708	249	6	-8	-146	-27
5	-7	862	87	6	-7	-118	-24
5	-6	507	10	6	-6	-65	-14
5	-5	250	-15	6	-5	4	1
5	-4	8	4	6	-4	-1	0
5	-3	2	0	6	-3	0	0
7	-19	0	0	8	-19	-3	0
7	-18	0	0	8	-18	-20	3
7	-17	0	0	8	-17	-169	21
7	-16	4	-4	8	-16	-1457	153
7	-15	29	-32	8	-15	-15302	-109
7	-14	235	-279	8	-14	534	62
7	-13	2375	-2684	8	-13	142	21
7	-12	-477	703	8	-12	72	13
7	-11	-141	223	8	-11	61	12
7	-10	-68	131	8	-10	56	12
7	-9	-44	110	8	-9	42	9
7	-8	-27	88	8	-8	18	4
7	-7	-10	42	8	-7	-2	-1
7	-6	-1	-4	8	-6	0	0
9	-21	0	0	10	-21	1	0
9	-20	1	3	10	-20	4	-1
9	-19	9	22	10	-19	70	-2
9	-18	81	190	10	-18	63	6
9	-17	870	2085	10	-17	-1	0
9	-16	359	725	10	-16	-4	-1
9	-15	21	51	10	-15	-4	-1
9	-14	-13	-14	10	-14	-3	-1
9	-13	-19	-20	10	-13	-2	0
9	-12	-23	-21	10	-12	0	0
9	-11	-24	-19	10	-11	1	0
9	-10	-19	-13	10	-10	0	0
9	-9	-7	-4	10	-9	-1	0
9	-8	2	0	10	-8	0	0
11	-23	0	0	12	-23	2	0
11	-22	-2	0	12	-22	8	1
11	-21	-18	-1	12	-21	-2	0
11	-20	-37	1	12	-20	-2	0
11	-19	5	-1	12	-19	-2	0
11	-18	6	-1	12	-18	-3	-1
11	-17	6	-2	12	-17	-4	-1
11	-16	7	-3	12	-16	-5	-1
11	-15	8	-4	12	-15	-6	-1
11	-14	9	-5	12	-14	-5	-1
11	-13	8	-6	12	-13	-3	-1
11	-12	5	-4	12	-12	-1	0
11	-11	1	-1	12	-11	1	0
11	-10	0	1	12	-10	0	0

Table A-4. (Cont.)

a) Earth on Mars

13	-24	1	-2	14	-24	0	0	13	-24	0	0	14	-24	0	0
13	-23	-1	2	14	-23	0	0	13	-23	0	0	14	-23	0	0
13	-22	0	1	14	-22	1	0	13	-22	0	0	14	-22	0	0
13	-21	0	1	14	-21	1	0	13	-21	0	0	14	-21	0	0
13	-20	0	1	14	-20	1	-1	13	-20	0	0	14	-20	0	0
13	-19	0	2	14	-19	1	-1	13	-19	0	0	14	-19	0	0
13	-18	0	3	14	-18	1	-2	13	-18	-1	0	14	-18	0	0
13	-17	1	3	14	-17	1	-2	13	-17	-1	0	14	-17	0	0
13	-16	1	4	14	-16	1	-2	13	-16	-1	0	14	-16	0	0
13	-15	1	3	14	-15	0	-1	13	-15	-1	0	14	-15	0	0
13	-14	1	2	14	-14	0	0	13	-14	0	0	14	-14	0	0
13	25	1	-3	14	25	-1	0	13	25	1	0	14	25	0	0
15	-24	1	0	16	-24	0	-1	15	-24	0	0	16	-24	0	0
15	-22	-1	0	16	-22	0	1	15	-22	0	0	16	-22	0	0
15	-21	-1	0	16	-21	0	1	15	-21	0	0	16	-21	0	0
15	-20	-1	0	16	-20	0	1	15	-20	0	0	16	-20	0	0
15	-19	-1	0	16	-19	0	1	15	-19	0	0	16	-19	0	0
15	-18	-1	0	16	-18	0	0	15	-18	0	0	16	-18	0	0
15	-17	-1	0	16	-17	0	0	15	-17	0	0	16	-17	0	0
15	25	1	1	16	25	0	-2	15	25	0	0	16	25	0	0
17	-25	0	1	18	-25	1	0	17	-25	0	0	18	-25	0	0
17	-24	-1	1	18	-24	1	0	17	-24	0	0	18	-24	0	0
17	-21	0	-1	18	-21	0	0	17	-21	0	0	18	-21	0	0
17	25	-2	3	18	25	4	0	17	25	-1	0	18	25	0	1
17	26	0	0	18	26	1	0	17	26	0	0	18	26	0	0
19	-25	-1	-1	20	-25	0	1	19	-25	0	0	20	-25	0	0
19	-24	-1	-1	20	-24	0	1	19	-24	0	0	20	-24	0	0
19	25	-3	-3	20	25	0	3	19	25	1	-1	20	25	-1	0
21	-25	1	0	22	-25	0	0	21	-25	0	0	22	-25	0	0
21	25	1	-1	22	25	0	0	21	25	0	0	22	25	0	0

Table A-4. (Cont.)

Secular Terms

a) Earth on Mars

J	DX		DY		DZ	
	COS	SIN	COS	SIN	COS	SIN
(IN UNITS OF $10^{**}(-16)$)						
(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)						
0	-6477798	0	-64455232	0	-525189	0
1	-301717	1004843	1004843	-504282	3741788	14283628
2	2121802	21391902	-21298252	2112377	174050	664888
3	297175	2982959	-2976416	296517	12146	46416
4	36916	370006	-369465	36861	1005	3840
5	4476	44828	-44779	4471	91	349
6	540	5406	-5401	540	9	34
7	65	652	-652	65	0	3
8	8	79	-79	8	0	0
9	0	10	-10	0	0	0
10	0	1	-1	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	11922	0	-301	0	-777	0
1	-127618	12854	-6427	-63809	5538	21141
2	-2970	299	-299	-2970	258	984
3	-138	14	-21	-207	18	69
4	-9	1	-2	-17	1	6
5	-1	0	0	-2	0	1

Table A-4. (Cont.)
 Periodic Terms
 b) Mercury on Mars

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-10835	0	-5658	0	-1417	0	-2	0	
0	1	90581	578	-1526	90334	0	0	0	0	
0	2	6121	-5520	5475	6152	138	-215	0	0	
0	3	184	-883	881	189	7	-34	0	0	
0	4	-52	-109	109	-51	0	-4	0	0	
0	5	-16	-9	9	-16	0	0	0	0	
0	6	-3	0	0	-3	0	0	0	0	
1	-8	-76	-566	-556	83	0	0	0	0	
1	-7	25	440	-106	-209	-7	-8	0	0	
1	-6	216	355	-141	-163	5	2	0	0	
1	-5	357	58	46	-386	7	0	0	0	
1	-4	621	-137	-120	-654	12	-5	0	0	
1	-3	682	-412	-406	-707	16	-18	0	0	
1	-2	-91	-110	-103	107	14	-35	0	0	
1	-1	-11	-40	34	114	12	-34	0	0	
1	0	-13172	-62529	63402	-13206	2831	5003	4	7	
1	1	-39	-6	7	-39	-9	0	0	0	
1	2	-9	2	-2	-9	-2	0	0	0	
1	3	0	1	-1	0	0	0	0	0	
1	6	0	-3	-3	0	0	0	0	0	
1	7	6	-24	-24	-6	0	0	0	0	
1	8	62	-237	-237	-62	0	0	0	0	
2	-8	2	-2	-2	0	0	0	0	0	
2	-7	2	-8	-6	2	0	0	0	0	
2	-6	-10	-19	-18	11	0	0	0	0	
2	-5	-49	-29	-28	49	0	0	0	0	
2	-4	-123	-5	-3	122	-2	-1	0	0	
2	-3	-158	74	79	152	-3	0	0	0	
2	-2	2	-5	-2	-25	-6	0	0	0	
2	-1	-26	11	-11	-25	-9	7	0	0	
2	0	-1337	-6366	6431	-1347	288	513	0	1	
2	8	-6	3	3	6	0	0	0	0	
3	-8	-2	0	0	1	0	0	0	0	
3	-7	-5	2	3	0	0	0	0	0	
3	-6	-4	8	8	3	0	0	0	0	
3	-5	0	17	16	0	0	0	0	0	
3	-4	5	17	16	-5	0	0	0	0	
3	-3	-13	5	2	13	0	0	0	0	
3	-2	2	2	-3	0	0	1	0	0	
3	-1	-2	0	-1	-2	0	0	0	0	
3	0	-204	-972	981	-206	44	78	0	0	
3	8	7	2	2	-7	0	0	0	0	
4	-8	0	1	0	0	0	0	0	0	
4	-7	2	3	-2	0	0	0	0	0	
4	-6	3	0	0	-2	0	0	0	0	
4	-5	2	0	0	-2	0	0	0	0	
4	-4	0	3	3	0	0	0	0	0	
4	-3	-1	0	0	2	0	0	0	0	
4	0	-37	-176	177	-37	8	14	0	0	
4	8	-2	-6	-6	2	0	0	0	0	
5	-7	0	-2	0	0	0	0	0	0	
5	0	-7	-35	35	-7	2	3	0	0	
5	8	-2	3	3	2	0	0	0	0	
6	0	-2	-7	7	-2	0	0	0	0	
6	8	2	0	0	-2	0	0	0	0	
7	0	0	-2	2	0	0	0	0	0	

Table A-4. (Cont.)
b) Mercury on Mars

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	123	0	0	0	26	0
0	1	0	0	5	-15	0	0	1	-3
0	2	-1	-1	0	-3	-1	-1	0	-1
1	-7	-1	0	0	0	-1	0	0	0
1	-4	0	0	0	0	0	-1	0	0
1	-3	0	-1	1	-1	1	-1	0	0
1	-2	3	-2	-1	-9	11	-3	0	-3
1	-1	85	-18	-18	-85	84	-18	-4	-18
1	0	-12	3	0	0	-4	1	0	1
1	1	1	0	0	1	0	0	0	0
2	-2	0	0	0	-1	1	0	0	0
2	-1	9	-2	-2	-9	9	-2	0	-2
2	0	-1	0	0	0	0	0	0	0
3	-1	1	0	0	-1	1	0	0	0

Table A-4. (Cont.)

Secular Terms

b) Mercury on Mars

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-129830	0	-223098	0	7028	0
1	-6047	3478	3478	-10107	-50072	-113497
2	42526	74044	-73719	42337	-2329	-5283
3	5956	10325	-10302	5943	-163	-369
4	740	1281	-1279	739	-13	-31
5	90	155	-155	90	-1	-3
6	11	19	-19	11	0	0
7	1	2	-2	1	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	41	0	-6	0	10	0
1	-442	258	-129	-221	-74	-168
2	-10	6	-6	-10	-3	-8
3	0	0	0	-1	0	-1

Table A-4. (Cont.)

Periodic Terms

c) Venus on Mars

		DX		DY		DZ		U/COS(1)	
		(IN UNITS OF 10**(-12))							
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-156068	0	-3073	0	-9054	0	-12	0
0	1	1515448	-172	-1309	1492401	0	0	0	0
0	2	125675	-3022	2890	124852	4740	3477	6	5
0	3	9112	-533	517	9057	628	445	1	1
0	4	701	-97	95	696	80	54	0	0
0	5	56	-18	17	56	10	7	0	0
0	6	5	-3	3	5	1	0	0	0
1	-11	4	2	2	-4	0	0	0	0
1	-10	32	21	21	-32	0	0	0	0
1	-9	277	177	177	-277	0	0	0	0
1	-8	2396	1533	1531	-2394	0	0	0	0
1	-7	21138	13522	13510	-21119	3	0	0	0
1	-6	192369	123004	122870	-192159	57	-13	0	0
1	-5	1851320	1182228	1180504	-1848639	1097	-213	1	0
1	-4	20353700	12936268	12907887	-20309897	30239	-5656	41	-8
1	-3	-6402275	-3432723	-3302748	6254269	61845	-9572	84	-13
1	-2	-19421408	-12260268	12086732	-19002823	-332850	47690	-451	65
1	-1	118665	-123189	123150	122411	-17805	-1928	-24	-3
1	0	-1519952	-684065	685186	-1519442	24513	47490	33	64
1	1	17374	6817	-6794	17410	-575	-828	-1	-1
1	2	2445	1062	-1058	2450	-81	-117	0	0
1	3	320	152	-152	320	-11	-16	0	0
1	4	40	21	-21	40	-2	-2	0	0
1	5	5	3	-3	5	0	0	0	0
2	-12	-15	-19	-19	15	0	0	0	0
2	-11	-128	-167	-167	128	0	0	0	0
2	-10	-1128	-1473	-1472	1127	0	0	0	0
2	-9	-10268	-13405	-13390	10257	0	0	0	0
2	-8	-98760	-128886	-128689	98610	-21	-6	0	0
2	-7	-1079967	-1406767	-1403377	1077382	-837	-249	-1	0
2	-6	675787	834234	793978	-646148	-4697	-1261	-6	-2
2	-5	1066539	1373090	-1131700	860045	22492	6070	30	8
2	-4	16119	14551	246537	-215049	4877	1438	7	2
2	-3	82634	87895	162517	-145617	2668	1229	4	2
2	-2	-15055	-17236	4495	-3690	213	1603	0	2
2	-1	2263	2306	-2243	2073	244	2872	0	4
2	0	-6144	-3164	3163	-6156	128	488	0	1
2	1	-110	-163	162	-112	5	40	0	0
2	2	-16	-28	28	-16	0	5	0	0
2	3	-2	-4	-4	-2	0	0	0	0
2	12	-2	-2	-2	2	0	0	0	0
3	-12	94	503	501	-94	0	0	0	0
3	-11	904	4833	4822	-903	0	0	0	0
3	-10	9888	52308	52169	-9862	24	23	0	0
3	-9	-9004	-40930	-38411	8587	223	190	0	0
3	-8	-10831	-53605	-53912	-5833	-938	-792	-1	-1
3	-7	-2045	-6509	-19728	5253	-338	-286	0	0
3	-6	-5786	-18863	-23649	6952	-350	-305	0	0
3	-5	-9890	-30946	-33103	10465	-401	-401	-1	-1
3	-4	-10398	-31198	-32120	10666	-276	-478	0	-1
3	-3	990	2667	3819	-1360	183	-507	0	-1
3	-2	-729	-2095	1931	-616	269	-773	0	-1
3	-1	13	27	-26	16	21	-57	0	0
3	0	-34	-1	1	-33	3	-7	0	0
3	1	-1	2	-2	-1	0	-1	0	0
3	11	1	6	6	-1	0	0	0	0
3	12	10	51	51	-10	0	0	0	0
4	-12	-440	1723	1650	417	-5	-10	0	0
4	-11	-550	2044	-866	-292	26	58	0	0
4	-10	-96	578	1169	236	13	28	0	0
4	-9	-248	1545	1789	304	17	37	0	0
4	-8	-470	3290	3430	498	28	61	0	0
4	-7	-784	6265	6367	801	41	102	0	0
4	-6	-1051	9587	9608	1054	40	147	0	0
4	-5	-846	8670	8431	815	-16	166	0	0
4	-4	45	-995	-1800	-134	-146	145	0	0
4	-3	-53	707	-569	-70	-178	190	0	0
4	-2	0	-17	15	-1	-7	6	0	0
4	-1	3	0	0	3	-1	2	0	0
4	9	0	-2	-2	0	0	0	0	0
4	10	5	-16	-16	-5	0	0	0	0
4	11	47	-159	-159	-46	0	0	0	0
4	12	516	-1770	-1766	-514	0	-1	0	0
5	-12	77	-106	-84	-60	0	4	0	0
5	-11	195	-277	-145	-93	0	-5	0	0
5	-10	322	-492	-479	-312	0	-11	0	0
5	-9	654	-1047	-1050	-656	0	-22	0	0
5	-8	1181	-1964	-1959	-1177	4	-37	0	0
5	-7	1640	-2819	-2779	-1614	14	-50	0	0
5	-6	1270	-2237	-2106	-1191	39	-48	0	0
5	-5	-185	373	655	349	77	-28	0	0
5	-4	109	-208	128	81	81	-34	0	0
5	-3	-5	11	-9	-4	0	0	0	0
5	-2	-1	0	0	-1	0	0	0	0
5	-1	-1	1	1	0	0	0	0	0
5	11	-11	14	14	11	0	0	0	0
5	12	-125	163	162	124	0	0	0	0
6	-12	-121	74	45	70	2	-4	0	0
6	-11	-324	204	67	91	-2	4	0	0
6	-10	-445	301	280	411	-4	8	0	0
6	-9	-747	525	517	735	-8	12	0	0
6	-8	-961	695	678	936	-15	14	0	0
6	-7	-649	478	437	590	-24	8	0	0
6	-6	138	-115	-186	-239	-34	-3	0	0
6	-5	-65	53	-18	-31	-31	0	0	0
6	-4	5	-5	3	4	2	0	0	0
6	-3	3	-1	-1	-3	0	0	0	0
6	-2	27	-16	-16	-27	0	0	0	0
6	-1	312	-184	-183	-311	0	0	0	0

Table A-4. (Cont.)

c) Venus on Mars

7	-12	184	-28	-13	-65	-5	4	0	0
7	-11	454	-74	-9	0	3	-2	0	0
7	-10	404	-78	-68	-335	5	-3	0	0
7	-9	443	-93	-90	-420	8	-2	0	0
7	-8	255	-55	-49	-223	11	2	0	0
7	-7	-75	21	31	121	12	7	0	0
7	-6	30	-8	0	6	10	5	0	0
7	-5	-4	1	0	-2	-1	0	0	0
7	10	-5	0	0	5	0	0	0	0
7	11	-56	8	8	55	0	0	0	0
7	12	-628	90	89	624	-1	1	0	0
8	-12	-216	-56	-1	19	7	0	0	0
8	-11	-469	-117	46	-154	-2	0	0	0
8	-10	-213	-47	-23	120	-4	-1	0	0
8	-9	-88	-19	-13	64	-4	-3	0	0
8	-8	33	4	9	-51	-4	-5	0	0
8	-7	-12	-2	0	0	-3	-3	0	0
8	-6	2	0	0	0	0	0	0	0
8	10	6	2	2	-6	0	0	0	0
8	11	81	21	21	-79	0	0	0	0
8	12	875	228	226	-868	2	0	0	0
9	-12	174	135	-33	38	-5	-3	0	0
9	-11	322	244	-166	213	0	1	0	0
9	-10	59	44	-16	20	0	2	0	0
9	-9	-8	-4	-15	22	0	2	0	0
9	-8	4	4	0	0	0	1	0	0
9	-7	0	0	0	1	0	0	0	0
9	-6	0	0	0	2	0	0	0	0
9	-5	0	0	0	2	0	0	0	0
9	-4	0	0	0	1	0	0	0	0
9	10	-5	-4	-3	4	0	0	0	0
9	11	-75	-58	-56	72	0	0	0	0
9	12	-759	-583	-575	749	-3	0	0	0
10	-12	-82	-146	82	-44	0	4	0	0
10	-11	-120	-214	200	-113	0	0	0	0
10	-10	-11	-24	36	-21	0	0	0	0
10	-9	-1	-5	3	-3	0	0	0	0
10	-8	0	0	0	-3	0	0	0	0
10	-7	-1	0	0	-3	0	0	0	0
10	-6	-2	0	0	-3	0	0	0	0
10	-5	-1	0	0	-2	0	0	0	0
10	8	0	-1	-1	0	0	0	0	0
10	9	-1	-2	-3	1	0	0	0	0
10	10	1	2	0	0	0	0	0	0
10	11	37	66	62	-35	0	0	0	0
10	12	333	593	579	-326	1	2	0	0
11	-12	5	87	-75	4	1	-2	0	0
11	-11	6	87	-95	11	0	0	0	0
11	-10	-1	12	-13	4	0	0	0	0
11	-9	0	1	-4	5	0	0	0	0
11	-8	2	1	-2	5	0	0	0	0
11	-7	3	1	-2	4	0	0	0	0
11	-6	2	0	-1	2	0	0	0	0
11	-5	1	0	0	1	0	0	0	0
11	7	0	0	1	0	0	0	0	0
11	8	0	2	2	0	0	0	0	0
11	9	0	3	4	0	0	0	0	0
11	10	0	0	4	0	0	0	0	0
11	11	-3	-38	-32	2	0	0	0	0
11	12	-29	-265	-252	28	0	-2	0	0
12	-12	2	-35	43	-4	0	0	0	0
12	-11	6	-3	10	-2	0	0	0	0
12	-10	0	-2	8	-6	0	0	0	0
12	-9	-3	-4	7	-6	0	0	0	0
12	-8	-3	-4	5	-5	0	0	0	0
12	-7	-2	-2	3	-3	0	0	0	0
12	-6	-1	-1	1	-1	0	0	0	0
12	7	0	-1	-1	0	0	0	0	0
12	8	0	-2	-3	0	0	0	0	0
12	9	1	-3	-4	-2	0	0	0	0
12	10	0	0	-4	-2	0	0	0	0
12	11	0	14	9	-2	0	0	0	0
12	12	-8	19	11	6	0	0	0	0

Table A-4. (Cont.)

c) Venus on Mars

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-91))			
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	2052	0	0	0	432	0
0	1	0	2	151	-8	0	0	32	-2
0	2	-1	-22	26	-2	-1	-22	5	0
0	3	0	-2	3	0	0	-4	1	0
0	4	0	0	0	0	0	-1	0	0
1	-8	0	0	0	0	1	-1	0	0
1	-7	0	0	0	0	5	-9	-1	-1
1	-6	0	0	0	0	45	-70	-10	-6
1	-5	0	1	0	-1	369	-575	-72	-46
1	-4	2	46	17	-4	3172	-4946	-518	-333
1	-3	34686	-54837	1747	1139	34150	-53828	473	296
1	-2	-5829	10960	-6009	-3168	-2539	5714	-743	-334
1	-1	649	-1516	-2836	-1277	467	-1057	-626	-277
1	0	-154	348	-57	-26	-112	254	-2	-1
1	1	0	1	-3	-1	-9	22	-3	-1
1	2	0	0	0	0	-1	3	0	0
2	-10	0	0	0	0	-1	0	0	0
2	-9	0	0	0	0	-5	4	1	1
2	-8	0	0	0	0	-40	31	4	5
2	-7	-13	9	4	6	-347	265	28	36
2	-6	-3749	2887	-182	-239	-3618	2781	-50	-64
2	-5	1388	-1127	619	761	1060	-876	100	121
2	-4	211	-178	163	193	318	-267	40	47
2	-3	171	-150	164	186	217	-190	36	41
2	-2	175	-159	173	191	195	-177	38	42
2	-1	5	-9	0	5	23	-26	2	3
2	0	0	1	1	1	2	-2	1	1
3	-11	0	0	0	0	2	0	0	0
3	-10	1	0	0	0	13	-2	0	-1
3	-9	137	-26	2	13	131	-25	1	3
3	-8	-66	15	-8	-38	-55	13	-1	-6
3	-7	-15	4	-4	-14	-22	5	-1	-3
3	-6	-16	4	-5	-18	-20	5	-1	-4
3	-5	-24	7	-9	-30	-30	9	-2	-6
3	-4	-38	12	-15	-47	-44	14	-3	-10
3	-3	-43	14	-17	-50	-47	15	-4	-11
3	-2	2	-1	0	0	-3	1	0	0
4	-12	-5	-1	0	0	-4	-1	0	0
4	-11	3	1	0	2	2	1	0	0
4	-10	1	0	0	1	1	0	0	0
4	-9	1	0	0	1	1	0	0	0
4	-8	2	0	0	2	2	0	0	0
4	-7	3	1	-1	5	4	1	0	1
4	-6	7	1	-1	9	8	1	0	2
4	-5	11	1	-2	14	13	1	0	3
4	-4	12	1	-1	14	13	1	0	3
4	-3	-1	0	0	-1	0	0	0	0
5	-9	0	0	0	-1	-1	0	0	0
5	-8	-1	-1	1	-2	-1	-1	0	0
5	-7	-2	-1	2	-3	-3	-2	0	-1
5	-6	-3	-2	2	-4	-4	-2	1	-1
5	-5	-3	-2	2	-4	-3	-2	0	-1
5	-4	1	0	0	0	0	0	0	0
6	-12	0	-1	0	0	0	-1	0	0
6	-9	0	0	-1	0	0	1	0	0
6	-8	1	1	-1	1	1	1	0	0
6	-7	1	1	-1	1	1	1	0	0
6	-6	1	1	-1	1	1	1	0	0
7	-12	0	1	-1	0	0	1	0	0
7	-9	0	0	1	0	0	0	0	0
7	-8	0	-1	1	0	0	-1	0	0
8	-12	0	-2	1	0	0	-2	0	0
9	-12	-1	1	-1	-1	-1	1	0	0
10	-12	1	-1	0	1	1	-1	0	0

Table A-4. (Cont.)

Secular Terms

c) Venus on Mars

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-241330	0	-13997273	0	-278209	0
1	-11229	218214	218214	-18776	1982137	-2601692
2	79048	4645524	-4625186	78697	92199	-121106
3	11071	647787	-646367	11047	6434	-8455
4	1375	80352	-80234	1373	532	-699
5	167	9735	-9724	167	48	-64
6	20	1174	-1173	20	5	-6
7	2	142	-142	2	0	0
8	0	17	-17	0	0	0
9	0	2	-2	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	2589	0	-11	0	-412	0
1	-27714	479	-239	-13857	2934	-3851
2	-645	11	-11	-645	136	-179
3	-30	0	-1	-45	10	-13
4	-2	0	0	-4	1	-1

Table A-4. (Cont.)

Periodic Terms

d) Jupiter on Mars

		DX		DY		DZ		U/COS(1)	
		(IN UNITS OF 10**(-12))		(IN UNITS OF 10**(-12))		(IN UNITS OF 10**(-12))		SECONDS OF ARC	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	2288968	0	-140916	0	-131970	0	-179	0
0	1	-6979041	28305	-24600	-6941844	0	0	0	0
0	2	1003479	-140468	140222	1004538	6409	-25511	9	-35
0	3	69432	-8887	8882	69523	516	-1676	1	-2
0	4	4151	-532	532	4160	42	-128	0	0
0	5	180	-25	25	181	4	-11	0	0
0	6	-4	0	0	-4	0	0	0	0
0	7	-3	0	0	-3	0	0	0	0
1	-10	-2	2	2	2	0	0	0	0
1	-9	-16	15	15	16	0	0	0	0
1	-8	-136	128	128	136	0	0	0	0
1	-7	-1127	1056	1056	1126	0	0	0	0
1	-6	-9369	8756	8748	9361	0	0	0	0
1	-5	-78079	72636	72555	77994	-64	1	0	0
1	-4	-649472	599948	599060	648537	-799	-16	-1	0
1	-3	-5309883	4844953	4834414	5298635	-11709	-914	-16	-1
1	-2	-39464168	35057007	34920224	39308302	-233280	-45956	-316	-62
1	-1	7844810	10308524	11009130	-9324879	-60749	668044	-42	1175
1	0	103261583	-86765691	87005613	101232736	-62682	-802541	-85	-1086
1	1	-600265	-14774860	14743471	-555878	-270716	-176677	-366	-239
1	2	-433247	-1417237	1415260	-431089	-11970	-9891	-16	-13
1	3	-61841	-151147	150988	-61688	-842	-729	-1	-1
1	4	-7804	-16841	16827	-7792	-70	-62	0	0
1	5	-954	-1925	1924	-955	-4	-6	0	0
1	6	-116	-224	224	-116	0	0	0	0
1	7	-14	-26	26	-14	0	0	0	0
1	8	-2	-3	3	-2	0	0	0	0
2	-11	0	-2	-2	0	0	0	0	0
2	-10	3	-14	-14	-3	0	0	0	0
2	-9	26	-113	-113	-26	0	0	0	0
2	-8	206	-913	-912	-206	0	0	0	0
2	-7	1652	-7360	-7353	-1651	-2	-2	0	0
2	-6	13072	-58836	-58767	-13057	-21	-17	0	0
2	-5	100857	-441103	-440379	-100712	-247	-17	0	0
2	-4	732856	-3439515	-3431540	-731465	-3097	-111	-4	0
2	-3	4430127	-21970087	-21876834	-4419670	-41301	-1108	-56	-1
2	-2	6914013	-48903115	-47916702	-7092030	-167966	-170815	-227	-231
2	-1	-17902939	80136807	-81678248	-18446035	-2277320	-2064370	-3083	-2795
2	0	-16860790	112432819	-112332880	-16864513	536356	394229	726	534
2	1	-1306024	8066602	-8061990	-1304087	38165	22131	52	3
2	2	-124709	722402	-721823	-124571	2194	1246	3	2
2	3	-13248	74419	-74366	-13236	165	93	0	0
2	4	-1474	8135	-8130	-1473	14	8	0	0
2	5	-168	919	-918	-168	1	0	0	0
2	6	-20	106	-106	-20	0	0	0	0
2	7	-2	12	-12	-2	0	0	0	0
2	8	0	1	-1	0	0	0	0	0
3	-11	0	-1	-1	0	0	0	0	0
3	-10	-2	-10	-10	2	0	0	0	0
3	-9	-15	-80	-80	15	0	0	0	0
3	-8	-112	-616	-616	111	0	0	0	0
3	-7	-776	-4643	-4641	775	-2	4	0	0
3	-6	-604	-3358	-3352	4792	-25	44	0	0
3	-5	-20938	-222545	-222801	20856	-267	476	0	1
3	-4	52324	-1189187	-1199001	-51772	-2263	4537	-3	6
3	-3	2821601	-2518174	-2839529	-2749025	13297	-1940	18	-3
3	-2	7058184	-82589	-14061060	-29488	432151	6033	585	8
3	-1	-10556804	8646066	-8843944	-10767075	-142049	-261715	-192	-354
3	0	-7315489	13843788	-13827912	-7309731	35683	69725	48	94
3	1	-548763	1037464	-1036420	-548199	2847	4185	4	6
3	2	-51504	96852	-96767	-51458	170	249	0	0
3	3	-5411	10143	-10136	-5407	13	19	0	0
3	4	-598	1119	-1118	-597	1	2	0	0
3	5	-68	127	-127	-68	0	0	0	0
3	6	-8	15	-15	-8	0	0	0	0
3	7	0	2	-2	0	0	0	0	0
4	-11	-1	0	-1	1	0	0	0	0
4	-10	-10	-8	-8	10	0	0	0	0
4	-9	-49	-56	-56	49	0	0	0	0
4	-8	-481	-394	-396	483	0	2	0	0
4	-7	-3093	-2621	-2645	3113	0	17	0	0
4	-6	-16871	-15576	-15909	17186	12	157	0	0
4	-5	-56989	-72339	-77216	62322	163	1088	0	1
4	-4	165420	-148920	-223846	-644987	1386	-870	2	-1
4	-3	1578684	467455	-598250	539792	39062	-22121	53	-30
4	-2	532797	608432	-2379759	-995408	91904	61983	124	84
4	-1	-1778758	-78035	61431	-1793268	-8554	-25629	-12	-35
4	0	-1312877	1396183	-1394097	-1311221	366	7251	0	10
4	1	-102629	109708	-109579	-102513	83	419	0	1
4	2	-9944	10832	-10821	-9935	5	26	0	0
4	3	-1058	1131	-1130	-1057	0	2	0	0
4	4	-118	126	-126	-118	0	0	0	0
4	5	-13	14	-14	-13	0	0	0	0
4	6	-2	2	-2	-2	0	0	0	0
5	-11	-2	0	0	3	0	0	0	0
5	-10	-17	0	0	17	0	0	0	0
5	-9	-112	-3	-3	114	0	0	0	0
5	-8	-673	-23	-27	693	3	4	0	0
5	-7	-3385	-241	-270	3625	28	33	0	0
5	-6	-10841	-2554	-2730	13856	172	164	0	0
5	-5	14059	-21906	-20698	24171	104	-345	0	0
5	-4	244183	-46302	27099	186970	2548	-6617	3	-9
5	-3	202805	277213	-206840	71905	11191	494	15	1
5	-2	47332	-22353	-281020	-318110	9057	19804	12	27
5	-1	-173045	-178693	177124	-174805	-644	-3402	-1	-5
5	0	-249435	187787	-187435	-249020	-211	636	0	1
5	1	-20758	15771	-15750	-20732	35	20732	0	0
5	2	-2081	1585	-1584	-2078	-7	2	0	0
5	3	-225	171	-171	-225	0	0	0	0
5	4	-25	19	-19	-25	0	0	0	0
5	5	-3	2	-2	-3	0	0	0	0
5	12	-1	0	0	1	0	0	0	0

Table A-4. (Cont.)

d) Jupiter on Mars

6	-12	0	0	0	1	0	0	0	0
6	-11	-2	1	3	4	0	0	0	0
6	-10	-18	13	14	20	0	0	0	0
6	-9	-103	71	76	112	2	0	0	0
6	-8	-474	296	350	563	12	2	0	0
6	-7	-1365	448	1078	2273	54	4	0	0
6	-6	1591	-5520	1555	7008	-33	-92	0	0
6	-5	33042	-35045	29199	30264	-387	-1327	-1	-2
6	-4	61331	25284	-21133	51248	1606	-1224	2	-2
6	-3	16794	48944	-29491	-25638	1369	1244	2	2
6	-2	206652	-156665	-160870	-244290	-675	8186	-1	11
6	-1	596	-78745	78349	119	125	-1167	0	-2
6	0	-240792	164731	-164379	-240291	-64	97	0	0
6	1	-21782	14961	-14939	-21751	-3	5	0	0
6	2	-2258	1553	-1551	-2256	0	0	0	0
6	3	-248	171	-170	-248	0	0	0	0
6	4	-28	19	-19	-28	0	0	0	0
6	5	-3	2	-2	-3	0	0	0	0
6	12	-4	2	2	4	0	0	0	0
7	-12	0	-2	3	1	0	0	0	0
7	-11	0	0	9	3	0	0	0	0
7	-10	-8	23	28	10	0	0	0	0
7	-9	-37	88	126	52	3	-2	0	0
7	-8	-131	104	447	247	10	-7	0	0
7	-7	-219	-1546	1561	965	-23	-16	0	0
7	-6	1449	-10402	9329	1840	-235	-181	0	0
7	-5	14370	-4010	3562	13661	113	-439	0	-1
7	-4	5679	8430	-8235	5048	341	-26	0	0
7	-3	-2148	2309	-3986	-3921	88	169	0	0
7	-2	1600	-3137	-946	-4326	142	-243	0	0
7	-1	-1804	1752	-1740	-1790	-21	34	0	0
7	0	-2667	1870	-1865	-2661	0	-1	0	0
7	1	-264	184	-184	-263	0	0	0	0
7	2	-28	20	-20	-28	0	0	0	0
7	3	-3	2	-2	-3	0	0	0	0
7	11	0	1	1	0	0	0	0	0
7	12	-5	13	13	5	0	0	0	0
8	-12	-2	-9	10	-2	0	0	0	0
8	-11	-2	-7	18	-5	0	0	0	0
8	-10	3	14	32	-8	0	0	0	0
8	-9	-21	5	125	-21	0	-3	0	0
8	-8	-270	-352	488	-89	-8	0	0	0
8	-7	-1085	-2176	2060	-895	-68	-2	0	0
8	-6	2253	-2948	2805	2210	-43	-101	0	0
8	-5	2582	865	-853	2499	63	-57	0	0
8	-4	-70	1254	-1198	-81	38	22	0	0
8	-3	-381	50	-59	-448	-3	20	0	0
8	-2	8	-175	125	-63	6	-5	0	0
8	-1	-74	-3	3	-74	-1	0	0	0
8	0	-29	17	-17	-29	0	0	0	0
8	1	-3	2	-2	-3	0	0	0	0
8	11	1	5	5	-1	0	0	0	0
8	12	10	35	35	-10	0	0	0	0
9	-12	-21	-18	17	-21	0	0	0	0
9	-11	-19	-14	20	-28	0	0	0	0
9	-10	-13	-2	24	-28	0	0	0	0
9	-9	-120	-45	89	-107	-2	1	0	0
9	-8	-512	-290	296	-465	-14	9	0	0
9	-7	12	-959	929	25	-24	-14	0	0
9	-6	718	-255	245	704	4	-23	0	0
9	-5	220	303	-297	215	12	-2	0	0
9	-4	-86	99	-95	-82	2	4	0	0
9	-3	-29	-18	20	-32	-1	1	0	0
9	-2	8	-12	10	6	0	0	0	0
9	-1	-2	-3	3	-2	0	0	0	0
9	10	1	1	1	-1	0	0	0	0
9	11	10	8	8	-10	0	0	0	0
9	12	62	43	43	-61	0	0	0	0
10	-12	-61	0	-2	-61	0	0	0	0
10	-11	-47	9	-7	-95	0	0	0	0
10	-10	-42	10	0	-46	0	0	0	0
10	-9	-148	10	-3	-141	-2	4	0	0
10	-8	-148	-207	203	-142	-7	0	0	0
10	-7	118	-183	180	117	-3	-6	0	0
10	-6	112	30	-30	110	2	-3	0	0
10	-5	0	43	-42	0	1	0	0	0
10	-4	-12	2	-2	-11	0	0	0	0
10	-3	0	-3	3	0	0	0	0	0
10	-2	1	0	0	1	0	0	0	0
10	10	4	0	0	-4	0	0	0	0
10	11	26	-1	-1	-26	0	0	0	0
10	12	125	-21	-21	-124	0	0	0	0
11	-12	-75	78	-80	-77	0	0	0	0
11	-11	-50	63	-64	-55	0	0	0	0
11	-10	-37	32	-31	-38	0	1	0	0
11	-9	-67	-20	-20	-66	-1	1	0	0
11	-8	-6	-63	62	-5	-2	0	0	0
11	-7	33	-14	14	33	0	-1	0	0
11	-6	9	11	-11	9	0	0	0	0
11	-5	-3	3	-3	-3	0	0	0	0
11	10	5	-5	-5	-5	0	0	0	0
11	11	31	-35	-35	-31	0	0	0	0
11	12	121	-151	-150	-121	0	0	0	0
12	-12	-3	177	-182	-5	0	0	0	0
12	-11	-27	91	-94	-29	0	0	0	0
12	-10	-22	20	-21	-23	0	0	0	0
12	-9	-13	-11	10	-13	0	0	0	0
12	-8	5	-9	9	5	0	0	0	0
12	-7	5	1	-1	5	0	0	0	0
12	-6	0	2	-2	0	0	0	0	0
12	-5	0	-11	-11	0	0	0	0	0
12	-4	4	-74	-75	-4	0	0	0	0
12	12	70	-209	-208	-71	0	0	0	0

Table A-4. (Cont.)

d) Jupiter on Mars

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-9278	0	0	0	-1954	0
0	1	2	21	3611	-386	0	0	759	-81
0	2	-21	-196	279	-28	-21	-196	59	-6
0	3	-1	-12	22	-2	-3	-30	7	-1
0	4	0	-1	2	0	0	-4	1	0
0	5	0	0	0	0	0	-1	0	0
1	-7	0	0	0	0	1	1	0	0
1	-6	0	0	0	0	5	5	1	-1
1	-5	1	1	2	-3	40	42	6	-6
1	-4	16	14	26	-29	324	341	49	-47
1	-3	266	231	318	-352	2630	2775	377	-360
1	-2	5977	5168	4594	-5005	21512	22925	2821	-2685
1	-1	164134	193803	84332	-71510	166575	191545	17417	-15195
1	0	20175	-29184	5743	-1248	35555	-11265	-715	1350
1	1	241	-2071	1183	168	3909	-2687	268	458
1	2	8	-55	60	10	466	-310	38	62
1	3	0	-3	4	1	57	-37	5	8
1	4	0	0	0	0	7	-5	1	1
1	5	0	0	0	0	1	-1	0	0
2	-8	0	0	0	0	-1	0	0	0
2	-7	0	0	0	0	-5	-1	0	1
2	-6	-2	0	-1	4	-40	-9	-2	6
2	-5	-21	-6	-12	46	-323	-75	-12	50
2	-4	-312	-90	-138	513	-2323	-598	-90	386
2	-3	-5517	-1507	-1641	6383	-20555	-4660	-682	2964
2	-2	-137433	-30361	-20665	93685	-156893	-33215	-4621	21660
2	-1	-204041	-29184	-12966	84821	-216335	-31975	-2425	16447
2	0	6093	584	-448	3455	-14396	-2468	233	-1460
2	1	179	-20	12	113	-1645	-322	42	-220
2	2	5	-1	1	5	-202	-39	6	-29
2	3	0	0	0	0	-25	-5	1	-4
2	4	0	0	0	0	-3	-1	0	0
3	-8	0	0	0	0	-1	0	0	0
3	-7	0	0	0	1	-5	1	0	1
3	-6	-4	1	3	9	-35	8	1	6
3	-5	-56	16	27	90	-272	62	11	45
3	-4	-780	254	305	931	-2009	454	80	328
3	-3	-11166	4494	3368	9103	-12808	2633	506	2080
3	-2	-13734	-18739	-11662	9804	-17281	-19511	-2625	2216
3	-1	-26872	-12854	-4828	8925	-28217	-14521	-836	1723
3	0	616	319	-176	341	-2050	-1075	114	-212
3	1	17	7	-5	12	-237	-127	17	-31
3	2	1	0	0	1	-29	-15	2	-4
3	3	0	0	0	0	-4	-2	0	-1
4	-8	0	0	0	0	-1	1	0	0
4	-7	-1	1	2	2	-4	6	1	1
4	-6	-9	12	19	14	-31	41	7	5
4	-5	-98	144	172	117	-204	275	49	36
4	-4	-876	1507	1298	809	-1088	1422	261	191
4	-3	-2170	-660	-401	1773	-2253	-846	-132	365
4	-2	357	-3017	-1864	-31	-144	-3297	-412	1
4	-1	-3113	-2509	-688	691	-3100	-2792	-114	145
4	0	49	47	-24	26	-240	-220	24	-25
4	1	1	1	-1	1	-28	-26	3	-4
4	2	0	0	0	0	-3	-3	0	0
5	-8	0	0	1	0	0	2	0	0
5	-7	0	5	7	0	0	12	2	0
5	-6	2	42	50	-2	1	73	14	0
5	-5	34	313	290	-21	-1	328	62	-1
5	-4	-370	150	159	313	-377	153	27	67
5	-3	-141	-246	-169	141	-150	-260	-41	24
5	-2	329	-280	-174	-170	266	-353	-40	-33
5	-1	-492	-557	-84	55	-463	-585	-15	14
5	0	4	6	-3	2	-38	-49	5	-4
5	1	0	0	0	0	-4	-6	1	-1
5	2	0	0	0	0	-1	-1	0	0
6	-8	1	1	2	-1	2	2	0	0
6	-7	7	8	10	-8	10	14	3	-2
6	-6	43	48	47	-39	39	55	11	-8
6	-5	-42	74	72	34	-43	76	14	8
6	-4	-53	-19	-7	49	-55	-15	-3	10
6	-3	9	-29	-22	-2	12	-36	-5	-2
6	-2	140	3	-1	-72	98	-59	-6	-11
6	-1	-453	-634	-20	11	-440	-634	-4	4
6	0	1	1	-1	0	-40	-58	6	-4
6	1	0	0	0	0	-5	-7	1	-1
6	2	0	0	0	0	-1	-1	0	0

Table A-4. (Cont.)
d) Jupiter on Mars

7	-9	0	0	0	-1	1	0	0	0
7	-8	3	1	1	-3	4	1	0	-1
7	-7	14	3	4	-13	14	5	1	-3
7	-6	3	20	19	-4	3	21	4	-1
7	-5	-13	5	7	11	-13	6	1	2
7	-4	-3	-6	-4	4	-4	-5	-1	1
7	-3	2	-2	-2	-1	1	-2	0	0
7	-2	-3	-3	-1	1	-4	-4	0	0
7	-1	-5	-7	0	0	-5	-8	0	0
7	0	0	0	0	0	-1	-1	0	0
8	-9	1	0	0	-1	1	0	0	0
8	-8	3	-1	-1	-3	3	-1	0	-1
8	-7	4	3	3	-4	4	4	1	-1
8	-6	-2	3	3	1	-2	3	1	0
8	-5	-2	-1	0	2	-2	0	0	0
8	-4	0	-1	-1	0	0	-1	0	0
9	-9	0	-1	-1	-1	1	-1	0	0
9	-8	1	0	0	-1	1	0	0	0
9	-7	0	1	1	0	0	1	0	0

Table A-4. (Cont.)
 Secular Terms
 d) Jupiter on Mars

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-47996123	0	-353208407	0	-8971041	0
1	-2235520	5506859	5506023	-3736389	63915494	38946489
2	15721127	117225585	-116712388	15651289	2973034	1812918
3	2201868	16346328	-16310477	2196994	207474	126561
4	273520	2027599	-2024632	273117	17161	10471
5	33163	245654	-245384	33126	1560	952
6	4001	29625	-29599	3998	150	92
7	483	3575	-3573	483	15	9
8	58	432	-432	58	2	0
9	7	52	-52	7	0	0
10	0	6	-6	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	65331	0	-2228	0	-13278	0
1	-699337	95239	-47619	-349669	94602	57645
2	-16277	2215	-2215	-16277	4400	2683
3	-757	103	-155	-1136	307	187
4	-47	7	-13	-94	25	15
5	-3	0	-1	-9	2	1
6	0	0	0	-1	0	0

Table A-4. (Cont.)

Periodic Terms

e) Saturn on Mars

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	111609	0	-5553	0	-2516	0	-3	0		
0	1	-319932	1613	-463	-313339	0	0	0	0		
0	2	53120	-5520	5496	53170	-268	-2192	0	-3		
0	3	4036	-421	420	4039	-10	-144	0	0		
0	4	289	-34	34	290	0	-11	0	0		
0	5	20	-3	3	20	0	0	0	0		
0	6	1	0	0	1	0	0	0	0		
1	-8	6	7	7	-6	0	0	0	0		
1	-7	47	60	60	-47	0	0	0	0		
1	-6	387	499	499	-387	0	0	0	0		
1	-5	3214	4181	4176	-3211	-2	3	0	0		
1	-4	26627	35035	34986	-26590	-25	34	0	0		
1	-3	216571	289953	289331	-216129	-362	453	0	1		
1	-2	1605744	2203947	2194192	-1600003	-7369	7542	-10	10		
1	-1	3005665	969621	703256	-2971378	-1380	66552	-2	90		
1	0	-3483189	-5945800	5995142	-4025612	-17550	-12070	-24	-16		
1	1	-3033015	-1163581	1160801	-3017578	-50148	94794	-68	128		
1	2	-370186	-113880	113709	-369380	-2343	4229	-3	6		
1	3	-42206	-12177	12164	-42146	-165	297	0	0		
1	4	-4852	-1358	1357	-4847	-14	25	0	0		
1	5	-565	-155	155	-564	-1	2	0	0		
1	6	-66	-18	18	-66	0	0	0	0		
1	7	-8	-2	2	-8	0	0	0	0		
2	-9	-3	4	4	3	0	0	0	0		
2	-8	-22	30	30	22	0	0	0	0		
2	-7	-174	241	241	173	0	0	0	0		
2	-6	-1377	1928	1926	1376	1	0	0	0		
2	-5	-10710	15117	15096	10697	12	10	0	0		
2	-4	-79462	113670	113457	79343	142	117	0	0		
2	-3	-517736	759284	757235	516952	1726	1436	2	2		
2	-2	-1878817	2976086	2971791	1893684	17323	16186	23	22		
2	-1	1535586	-1803346	2199216	1419960	371512	314767	503	426		
2	0	5171528	-8026751	8032291	5149617	-68302	-53520	-92	-72		
2	1	277635	-685970	685144	277938	-11684	-1752	-16	-2		
2	2	19793	-61292	61231	19797	-572	-120	-1	0		
2	3	1828	-6338	6333	1828	-41	-9	0	0		
2	4	188	-695	694	188	-3	0	0	0		
2	5	20	-79	79	20	0	0	0	0		
2	6	2	-9	9	2	0	0	0	0		
2	7	0	-1	1	0	0	0	0	0		
3	-9	0	0	1	0	0	0	0	0		
3	-8	4	8	8	-4	0	0	0	0		
3	-7	26	61	61	-27	0	0	0	0		
3	-6	125	463	463	-127	0	0	0	0		
3	-5	65	3394	3404	-93	2	-1	0	0		
3	-4	-9196	23214	23388	8683	18	7	0	0		
3	-3	-150438	134948	138041	139669	130	847	0	1		
3	-2	-537667	417789	463838	253514	52	12705	0	17		
3	-1	496652	-405954	452528	510629	47669	57318	65	78		
3	0	1025964	-1129818	1130028	1024589	-9722	-10921	-13	-15		
3	1	71995	-92287	92182	71959	-1324	-820	-2	-1		
3	2	6134	-8284	8276	6130	-67	-45	0	0		
3	3	620	-858	857	619	-5	-3	0	0		
3	4	67	-94	94	67	0	0	0	0		
3	5	8	-11	11	8	0	0	0	0		
3	6	0	-1	1	0	0	0	0	0		
4	-8	0	-4	-4	0	0	0	0	0		
4	-7	5	-22	-23	-5	0	0	0	0		
4	-6	33	-80	-91	-33	0	0	0	0		
4	-5	201	129	-5	-195	0	0	0	0		
4	-4	168	5431	3650	23	57	-13	0	0		
4	-3	-27052	27511	5938	31132	559	77	1	0		
4	-2	-108795	31206	68600	15505	-1293	3663	-2	5		
4	-1	108063	-52818	57332	111289	4382	7763	6	11		
4	0	153215	-120818	120802	153085	-988	-1663	-1	-2		
4	1	11310	-9688	9677	11301	-122	-128	0	0		
4	2	1001	-879	878	1000	-6	-7	0	0		
4	3	103	-91	91	103	0	0	0	0		
4	4	11	-10	10	11	0	0	0	0		
4	5	1	-1	1	1	0	0	0	0		

Table A-4. (Cont.)

e) Saturn on Mars

5	-8	-2	0	0	3	0	0	0	0
5	-7	-9	-2	-1	12	0	0	0	0
5	-6	-12	-35	-23	36	0	0	0	0
5	-5	191	-228	-103	37	-5	-6	0	0
5	-4	1026	442	1373	696	-13	-45	0	0
5	-3	-4761	6488	-3715	5114	256	34	0	0
5	-2	-17864	-1604	11229	-485	-486	708	-1	1
5	-1	18939	-4032	4415	19400	319	910	0	1
5	0	20357	-10899	10895	20341	-76	-221	0	0
5	1	1530	-868	867	1528	-9	-16	0	0
5	2	138	-80	80	138	0	0	0	0
5	3	14	-8	8	14	0	0	0	0
5	4	2	0	0	2	0	0	0	0
6	-8	0	0	1	0	0	0	0	0
6	-7	-5	0	4	1	0	0	0	0
6	-6	-32	-16	8	4	0	0	0	0
6	-5	-32	-130	14	-92	-4	2	0	0
6	-4	557	-77	420	509	-9	-26	0	0
6	-3	-983	1381	-1358	512	68	21	0	0
6	-2	-2482	-1136	1904	-208	-119	106	0	0
6	-1	2878	125	-97	2934	17	97	0	0
6	0	2527	-791	791	2525	-3	-27	0	0
6	1	192	-63	63	192	0	-2	0	0
6	2	18	-6	6	18	0	0	0	0
6	3	2	0	0	2	0	0	0	0
7	-7	0	4	0	0	0	0	0	0
7	-6	-14	6	-9	0	0	0	0	0
7	-5	-42	-62	37	-61	-3	2	0	0
7	-4	185	-20	79	186	-1	-9	0	0
7	-3	-215	246	-298	-9	13	7	0	0
7	-2	-294	-270	309	-9	-24	12	0	0
7	-1	392	122	-121	398	0	10	0	0
7	0	299	-31	31	299	0	-3	0	0
7	1	23	-3	3	23	0	0	0	0
7	2	2	0	0	2	0	0	0	0
7	10	0	-1	-1	0	0	0	0	0
8	-7	1	1	0	0	0	0	0	0
8	-6	-5	8	-9	-2	0	0	0	0
8	-5	-15	-24	19	-19	-1	0	0	0
8	-4	46	2	7	48	0	-2	0	0
8	-3	-44	36	-51	-18	2	2	0	0
8	-2	-29	-48	46	6	-4	1	0	0
8	-1	48	31	-31	49	0	0	0	0
8	0	34	4	-4	34	0	0	0	0
8	1	3	0	0	3	0	0	0	0
8	10	-1	0	0	1	0	0	0	0
9	-7	1	0	0	1	0	0	0	0
9	-6	-2	3	-4	-2	0	0	0	0
9	-5	-3	-7	7	-4	0	0	0	0
9	-4	9	2	0	10	0	0	0	0
9	-3	-8	4	-7	-5	0	0	0	0
9	-2	-2	-7	6	2	0	0	0	0
9	-1	5	6	-6	5	0	0	0	0
9	0	4	1	-1	4	0	0	0	0
10	-6	0	0	-1	0	0	0	0	0
10	-5	0	-2	2	0	0	0	0	0
10	-4	2	0	0	2	0	0	0	0
10	-3	-1	0	0	-1	0	0	0	0
10	-2	0	-1	0	0	0	0	0	0

Table A-4. (Cont.)
e) Saturn on Mars

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)				(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-422	0	0	0	-89	0
0	1	0	1	184	-15	0	0	39	-3
0	2	0	-6	11	-1	0	-6	2	0
0	3	0	0	1	0	0	-1	0	0
1	-5	0	0	0	0	2	-2	0	0
1	-4	0	-1	-1	-1	18	-14	-2	-3
1	-3	8	-10	-14	-12	146	-116	-16	-20
1	-2	179	-221	-198	-192	1225	-947	-119	-151
1	-1	11018	-6893	-3271	-5216	11194	-7618	-761	-1113
1	0	1712	-7501	108	-175	2744	-8192	86	71
1	1	39	-497	265	21	318	-1272	138	36
1	2	1	-12	13	1	38	-149	19	5
1	3	0	-1	1	0	5	-18	2	1
1	4	0	0	0	0	1	-2	0	0
2	-6	0	0	0	0	1	1	0	0
2	-5	1	1	1	-2	11	8	1	-2
2	-4	10	9	14	-17	86	63	10	-13
2	-3	174	139	159	-205	676	489	72	-99
2	-2	3687	2672	1944	-2689	5059	3547	498	-707
2	-1	14569	9320	4402	-6834	14902	9518	895	-1401
2	0	-134	-557	210	-280	1263	338	-51	89
2	1	-5	-28	16	-3	145	24	-4	19
2	2	0	-1	1	0	18	3	-1	2
2	3	0	0	0	0	2	0	0	0
3	-5	1	-1	-2	-1	3	-3	-1	-1
3	-4	6	-15	-17	-8	24	-19	-4	-4
3	-3	69	-170	-127	-69	162	-68	-15	-25
3	-2	751	895	615	-537	948	1050	149	-132
3	-1	2055	1840	843	-927	2123	1916	168	-187
3	0	-29	-61	36	-36	171	119	-12	13
3	1	-1	-3	1	-1	20	13	-2	3
3	2	0	0	0	0	2	2	0	0
4	-5	-2	0	0	2	-3	0	0	1
4	-4	-14	0	-1	11	-9	-3	-1	2
4	-3	34	-61	-47	-28	44	-40	-8	-7
4	-2	92	195	129	-67	116	214	30	-16
4	-1	222	273	121	-95	231	290	24	-19
4	0	-3	-7	5	-4	18	20	-2	2
4	1	0	0	0	0	2	2	0	0
5	-5	0	1	1	0	0	1	0	0
5	-4	-7	0	-1	6	-6	-1	0	1
5	-3	11	-12	-9	-8	11	-9	-2	-2
5	-2	6	34	22	-5	9	36	5	-1
5	-1	21	36	15	-8	21	39	3	-2
5	0	0	-1	1	0	2	3	0	0
6	-5	0	1	1	0	0	1	0	0
6	-4	-2	-1	0	2	-2	-1	0	0
6	-3	3	-2	-1	-2	2	-1	0	0
6	-2	0	5	3	0	0	5	1	0
6	-1	2	4	2	-1	2	5	0	0
7	-2	0	1	0	0	0	1	0	0
7	-1	0	1	0	0	0	1	0	0

Table A-4. (Cont.)

Secular Terms

e) Saturn on Mars

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-1904634	0	-18872838	0	-735771	0
1	-88712	294223	294223	-148271	5242109	374135
2	623863	6263664	-6236242	621091	243837	17416
3	87377	873426	-871511	87183	17016	1216
4	10854	108340	-108181	10838	1407	101
5	1316	13126	-13111	1315	128	9
6	159	1583	-1582	159	12	0
7	19	191	-191	19	1	0
8	2	23	-23	2	0	0
9	0	3	-3	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	3491	0	-89	0	-1089	0
1	-37367	3779	-1890	-18684	7759	554
2	-870	88	-88	-870	361	26
3	-40	4	-6	-61	25	2
4	-3	0	-1	-5	2	0

Table A-4. (Cont.)
Periodic Terms
f) Uranus on Mars

		DX		DY		DZ		U/COS(1)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	2028	0	13	0	-131	0	0	0	
0	1	-5843	-12	-7	-5806	0	0	0	0	
0	2	951	13	-13	952	16	-9	0	0	
0	3	66	2	-2	67	1	0	0	0	
0	4	4	0	0	4	0	0	0	0	
1	-7	2	0	0	-2	0	0	0	0	
1	-6	15	-3	-3	-15	0	0	0	0	
1	-5	128	-24	-24	-128	0	0	0	0	
1	-4	1072	-201	-201	-1071	0	0	0	0	
1	-3	8877	-1671	-1667	-8859	9	4	0	0	
1	-2	68080	-12759	-12700	-67814	140	58	0	0	
1	-1	134422	-6998	-4979	-127578	2242	1012	3	1	
1	0	-152059	35737	-35789	-176476	-150	-238	0	0	
1	1	-137978	8103	-8090	-137307	-1938	1293	-3	2	
1	2	-16775	742	-741	-16739	-89	60	0	0	
1	3	-1900	77	-77	-1897	-6	4	0	0	
1	4	-218	9	-9	-217	0	0	0	0	
1	5	-25	0	0	-25	0	0	0	0	
1	6	-3	0	0	-3	0	0	0	0	
2	-7	7	-4	-4	-7	0	0	0	0	
2	-6	53	-30	-30	-53	0	0	0	0	
2	-5	425	-241	-241	-424	0	0	0	0	
2	-4	3301	-1873	-1870	-3296	2	-3	0	0	
2	-3	23844	-13491	-13463	-23793	19	-35	0	0	
2	-2	130486	-73355	-73290	-130307	299	-504	0	-1	
2	-1	-19756	14408	-21067	-41727	6097	-10564	8	-14	
2	0	-375968	212484	-212421	-376813	-915	1587	-1	2	
2	1	-34084	16500	-16488	-34036	-206	274	0	0	
2	2	-3077	1392	-1391	-3074	-10	13	0	0	
2	3	-319	141	-141	-319	0	0	0	0	
2	4	-35	15	-15	-35	0	0	0	0	
2	5	-4	2	-2	-4	0	0	0	0	
3	-6	5	-2	-2	-5	0	0	0	0	
3	-5	46	-21	-21	-45	0	0	0	0	
3	-4	410	-222	-218	-406	0	0	0	0	
3	-3	3411	-2091	-2019	-3338	3	-7	0	0	
3	-2	16941	-10457	-8777	-15245	45	-102	0	0	
3	-1	-5491	3669	-4464	-7406	718	-1355	1	-2	
3	0	-45753	27417	-27407	-45787	-113	212	0	0	
3	1	-3775	2097	-2095	-3771	-19	30	0	0	
3	2	-331	178	-178	-330	0	1	0	0	
3	3	-34	18	-18	-34	0	0	0	0	
3	4	-4	2	-2	-4	0	0	0	0	
4	-5	4	-2	-2	-4	0	0	0	0	
4	-4	33	-11	-17	-36	0	0	0	0	
4	-3	361	-215	-282	-394	0	0	0	0	
4	-2	1802	-1241	-755	-1349	6	-17	0	0	
4	-1	-828	587	-664	-988	66	-136	0	0	
4	0	-4408	2800	-2799	-4409	-11	22	0	0	
4	1	-352	212	-212	-351	-2	3	0	0	
4	2	-31	18	-18	-31	0	0	0	0	
4	3	-3	2	-2	-3	0	0	0	0	
5	-4	2	-1	1	-2	0	0	0	0	
5	-3	31	-13	-42	-46	0	0	0	0	
5	-2	180	-140	-50	-103	0	-2	0	0	
5	-1	-101	78	-85	-114	6	-12	0	0	
5	0	-389	262	-262	-389	0	2	0	0	
5	1	-30	20	-20	-30	0	0	0	0	
5	2	-3	2	-2	-3	0	0	0	0	
6	-4	0	0	1	0	0	0	0	0	
6	-3	2	0	-6	-5	0	0	0	0	
6	-2	17	-15	-2	-7	0	0	0	0	
6	-1	-11	9	-10	-12	0	-1	0	0	
6	0	-33	24	-24	-33	0	0	0	0	
6	1	-3	2	-2	-3	0	0	0	0	
7	-2	2	-2	0	0	0	0	0	0	
7	-1	-1	1	-1	-1	0	0	0	0	
7	0	-3	2	-2	-3	0	0	0	0	

Table A-4. (Cont.)
f) Uranus on Mars

J	K	NDZ ----- (IN UNITS OF 10**(-4))		NU SECONDS OF ARC		D (LONG.) -----		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-8	0	0	0	-2	0
0	1	0	0	3	0	0	0	1	0
1	-4	0	0	0	0	0	-1	0	0
1	-3	0	0	0	0	-1	-4	-1	0
1	-2	-1	-6	-6	1	-7	-37	-5	1
1	-1	-65	-299	-147	32	-67	-331	-34	7
1	0	-13	-335	-2	1	-19	-365	2	0
1	1	0	-22	11	0	-2	-57	6	0
1	2	0	-1	1	0	0	-7	1	0
1	3	0	0	0	0	0	-1	0	0
2	-4	0	0	0	0	-1	-2	0	0
2	-3	-2	-4	-4	3	-10	-18	-3	1
2	-2	-42	-73	-57	33	-78	-137	-19	11
2	-1	-385	-682	-334	189	-388	-688	-70	39
2	0	9	2	-15	9	-27	-62	4	-2
2	1	0	0	0	0	-3	-7	1	0
2	2	0	0	0	0	0	-1	0	0
3	-3	1	1	0	-1	0	-2	0	0
3	-2	-8	-13	-10	6	-13	-21	-3	2
3	-1	-50	-83	-40	24	-50	-84	-8	5
3	0	1	1	-2	1	-3	-7	0	0
3	1	0	0	0	0	0	-1	0	0
4	-2	-1	-2	-1	1	-2	-2	0	0
4	-1	-5	-8	-4	2	-5	-8	-1	0
4	0	0	0	0	0	0	-1	0	0
5	-1	0	-1	0	0	0	-1	0	0

Table A-4. (Cont.)

Secular Terms

f) Uranus on Mars

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	4528	0	-339074	0	-3440	0
1	211	5286	5286	352	24510	43218
2	-1483	112534	-112042	-1476	1140	2012
3	-208	15692	-15658	-207	80	140
4	-26	1946	-1944	-26	7	12
5	-3	236	-236	-3	0	1
6	0	28	-28	0	0	0
7	0	3	-3	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	63	0	0	0	-5	0
1	-671	-9	4	-336	36	64
2	-16	0	0	-16	2	3
3	-1	0	0	-1	0	0

Table A-4. (Cont.)
Periodic Terms
g) Neptune on Mars

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	603	0	0	0	-41	0	0	0	
0	1	-1781	-8	-8	-1760	0	0	0	0	
0	2	275	0	0	275	4	-9	0	0	
0	3	20	1	-1	20	0	0	0	0	
0	4	1	0	0	1	0	0	0	0	
1	-6	-2	5	5	2	0	0	0	0	
1	-5	-13	45	45	13	0	0	0	0	
1	-4	-103	374	374	103	0	0	0	0	
1	-3	-829	3030	3023	827	0	2	0	0	
1	-2	-5818	21966	21872	5791	-4	34	0	0	
1	-1	8207	9447	7570	-8868	208	694	0	1	
1	0	20508	-62478	63328	18741	8	-126	0	0	
1	1	-7183	-12330	12296	-7137	-504	-49	-1	0	
1	2	-975	-1245	1243	-972	-23	-2	0	0	
1	3	-113	-134	134	-113	-2	0	0	0	
1	4	-13	-15	15	-13	0	0	0	0	
1	5	-2	-2	2	-2	0	0	0	0	
2	-7	-3	-2	-2	3	0	0	0	0	
2	-6	-21	-18	-18	21	0	0	0	0	
2	-5	-173	-144	-144	173	0	0	0	0	
2	-4	-1373	-1147	-1145	1371	-4	2	0	0	
2	-3	-10347	-8639	-8620	10324	-44	19	0	0	
2	-2	-63684	-53137	-52982	63492	-627	264	-1	0	
2	-1	3910	2740	-8503	9463	-13274	5596	-18	8	
2	0	187504	156251	-156348	187474	1908	-805	3	-1	
2	1	14423	12575	-12564	14413	269	-113	0	0	
2	2	1211	1081	-1080	1210	13	-5	0	0	
2	3	122	110	-110	122	0	0	0	0	
2	4	13	12	-12	13	0	0	0	0	
2	5	1	1	-1	1	0	0	0	0	
3	-5	-6	-2	-2	6	0	0	0	0	
3	-4	-33	-24	-24	34	0	0	0	0	
3	-3	-112	-253	-244	127	0	0	0	0	
3	-2	-579	-1488	-1257	972	-14	-15	0	0	
3	-1	26	231	-368	82	-272	-29	0	0	
3	0	2263	4012	-4013	2262	40	4	0	0	
3	1	168	317	-317	168	5	0	0	0	
3	2	14	27	-27	14	0	0	0	0	
3	3	1	3	-3	1	0	0	0	0	
4	-4	0	-1	0	0	0	0	0	0	
4	-3	0	-10	2	0	0	0	0	0	
4	-2	7	-21	-23	12	0	0	0	0	
4	-1	-3	5	-7	-3	-3	-2	0	0	
4	0	8	64	-64	8	0	0	0	0	
4	1	0	5	-5	0	0	0	0	0	

Table A-4. (Cont.)
g) Neptune on Mars

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))			
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-2	0	0	0	0	0
0	1	0	0	1	0	0	0	0	0
1	-3	0	0	0	0	2	0	0	0
1	-2	3	1	1	-3	14	4	0	-2
1	-1	114	36	18	-57	116	33	3	-12
1	0	18	-25	1	-3	28	-21	0	1
1	1	1	-2	1	0	4	-4	0	0
2	-4	0	0	0	0	-1	1	0	0
2	-3	-1	1	1	1	-6	7	1	1
2	-2	-19	23	19	16	-46	55	7	6
2	-1	-283	340	168	140	-284	341	35	29
2	0	5	-8	8	6	-21	24	-2	-1
2	1	0	0	0	0	-2	3	0	0
3	-2	-1	0	0	1	-1	1	0	0
3	-1	-7	4	2	4	-7	4	0	1
3	0	0	0	0	0	-1	0	0	0

Table A-4. (Cont.)
 Secular Terms
 g) Neptune on Mars

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-189	0	-98340	0	-3635	0
1	-9	1533	1533	-15	25899	13853
2	62	32638	-32495	62	1205	645
3	9	4551	-4541	9	84	45
4	1	565	-564	1	7	4
5	0	68	-68	0	0	0
6	0	8	-8	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	18	0	-0	0	-5	0
1	-195	0	0	-97	38	21
2	-5	0	0	-4	2	1

Table A-5. Jupiter
Periodic Terms.
a) Mercury on Jupiter

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	-23640	0	-4560	0	-1413	0	-1	0		
0	1	295771	354	-526	295738	0	0	0	0		
0	2	4928	-4538	4537	4930	-4	-24	0	0		
0	3	42	-246	246	42	0	-1	0	0		
0	4	-5	-10	10	-5	0	0	0	0		
1	-3	1	2	2	-1	0	0	0	0		
1	-2	0	1	1	0	0	0	0	0		
1	0	29266	-57173	57713	28573	4376	5521	2	2		
2	0	2975	-5834	5868	2916	444	563	0	0		
3	0	454	-892	896	446	68	86	0	0		
4	0	82	-162	162	81	12	16	0	0		
5	0	16	-32	32	16	2	3	0	0		
6	0	3	-7	7	3	0	0	0	0		
7	0	0	-1	2	0	0	0	0	0		

		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	117	0	0	0	25	0	
0	1	0	0	-2	-4	0	0	0	-1	
1	-2	1	0	1	-1	2	1	0	0	
1	-1	23	11	11	-23	23	11	2	-5	
1	0	-2	-1	0	0	-1	0	0	0	
2	-1	2	1	1	-2	2	1	0	0	

Table A-5. (Cont.)
 Secular Terms
 a) Mercury on Jupiter

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-1348	0	-3369	0	419	0
1	-33	27	27	-54	-5785	-2048
2	447	1122	-1120	447	-139	-49
3	32	81	-81	32	-5	-2
4	2	5	-5	2	0	0

NDZ NU $U/COS(I)$
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N =THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T =TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	1	0	-1	0	1	0
1	-12	5	-3	-6	-16	-6
12	0	-1	0	0	0	0

Table A-5. (Cont.)
 Periodic Terms
 b) Venus on Jupiter

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-305000	0	-4178	0	-1291	0	-1	0	
0	1	4304562	301	-505	4301223	0	0	0	0	
0	2	110594	-4155	4152	110541	375	-333	0	0	
0	3	4068	-267	267	4067	22	-20	0	0	
0	4	175	-15	15	175	1	-1	0	0	
0	5	8	0	0	8	0	0	0	0	
1	-5	0	-2	-2	0	0	0	0	0	
1	-4	4	-11	-11	-4	0	0	0	0	
1	-3	11	-48	-48	-11	0	-2	0	0	
1	-2	-27	-49	-46	27	2	-9	0	0	
1	-1	-9	-21	19	0	-1	-2	0	0	
1	0	-819668	-1571475	1571077	-820964	64411	26535	26	11	
1	1	-10	-14	14	-10	-1	0	0	0	
2	-6	-1	2	2	1	0	0	0	0	
2	-5	-9	12	12	9	0	0	0	0	
2	-4	-55	76	76	55	0	0	0	0	
2	-3	-208	299	297	207	0	0	0	0	
2	-2	3	-5	-22	-16	0	2	0	0	
2	-1	-38	55	-55	-38	0	11	0	0	
2	0	-2808	-5378	5377	-2813	221	91	0	0	
3	-6	2	0	0	-2	0	0	0	0	
3	-5	8	1	1	-8	0	0	0	0	
3	-4	25	3	3	-25	0	0	0	0	
3	-3	-2	0	0	3	0	0	0	0	
3	-2	4	0	0	3	0	0	0	0	
3	0	-14	-28	28	-14	1	0	0	0	
4	-5	0	-2	-2	0	0	0	0	0	

		NDZ		NU		D (LONG.)		D LOG(R)		
		----- (IN UNITS OF 10**(-4) SECONDS OF ARC) -----								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	1708	0	0	0	360	0	
0	1	0	0	5	-3	0	0	1	-1	
1	-3	1	0	-1	-2	3	-2	0	-1	
1	-2	15	-8	-16	-30	45	-23	-5	-9	
1	-1	623	-325	-325	-623	621	-324	-68	-131	
1	0	-45	24	0	0	-15	8	2	3	
2	-1	2	-1	-1	-2	2	-1	0	0	

b) Venus on Jupiter

J	COS	SIN	COS	SIN	COS	SIN
0	36	0	-1	0	14	0
1	-744	16	-8	-371	-193	-229
2	-9	0	0	-9	-5	-6
5	0	0	0	-1	0	0
10	1	0	0	0	0	0
12	0	-1	0	0	0	0

Table A-5. (Cont.)
Periodic Terms
c) Earth on Jupiter

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-381410	0	-20504	0	1168	0	0	0	
0	1	5415199	1338	-2617	5410386	0	0	0	0	
0	2	141399	-20387	20356	141330	-711	111	0	0	
0	3	4986	-1446	1445	4985	-42	9	0	0	
0	4	197	-92	92	197	-2	0	0	0	
0	5	8	-6	6	8	0	0	0	0	
1	-7	1	0	0	-1	0	0	0	0	
1	-6	7	0	0	-7	0	0	0	0	
1	-5	43	-2	-2	-43	0	0	0	0	
1	-4	218	-30	-30	-217	0	3	0	0	
1	-3	712	-243	-242	-709	-2	15	0	0	
1	-2	2	-984	-971	27	-5	54	0	0	
1	-1	26	-96	53	157	-6	8	0	0	
1	0	82140	-3039147	3040153	82079	-1732	-69506	-1	-28	
1	1	-46	-59	59	-45	2	5	0	0	
1	2	-6	-4	4	-6	0	0	0	0	
2	-7	-2	0	0	2	0	0	0	0	
2	-6	-16	-4	-4	16	0	0	0	0	
2	-5	-115	-23	-23	115	0	0	0	0	
2	-4	-683	-85	-84	682	0	0	0	0	
2	-3	-2566	-136	-133	2550	3	0	0	0	
2	-2	42	0	18	-180	7	0	0	0	
2	-1	-438	-24	24	-437	42	0	0	0	
2	0	669	-25488	25496	669	-13	-583	0	0	
3	-7	0	3	2	0	0	0	0	0	
3	-6	-4	16	16	4	0	0	0	0	
3	-5	-13	82	82	13	0	0	0	0	
3	-4	-24	244	242	23	0	0	0	0	
3	-3	-17	-10	-25	14	0	-1	0	0	
3	-2	-2	32	-32	-4	0	-5	0	0	
3	-1	-3	0	0	-3	0	0	0	0	
3	0	9	-321	321	9	0	-7	0	0	
4	-7	3	0	0	-2	0	0	0	0	
4	-6	12	2	2	-12	0	0	0	0	
4	-5	29	4	4	-28	0	0	0	0	
4	-4	-2	3	3	4	0	0	0	0	
4	-3	3	0	0	3	0	0	0	0	
4	0	0	-5	5	0	0	0	0	0	
4	8	-2	0	0	2	0	0	0	0	
5	-7	0	-3	0	0	0	0	0	0	
5	-6	0	-4	-4	0	0	0	0	0	
5	8	0	3	2	0	0	0	0	0	
6	-7	-1	0	0	0	0	0	0	0	
6	8	2	0	0	-2	0	0	0	0	
7	8	0	-1	-1	0	0	0	0	0	
		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	2149	0	0	0	452	0	
0	1	0	0	9	-16	0	0	2	-3	
0	2	0	-1	1	-1	0	-1	0	0	
1	-3	1	0	0	-3	6	0	0	-1	
1	-2	29	1	2	-58	87	2	1	-18	
1	-1	1205	33	33	-1205	1202	32	7	-253	
1	0	-87	-2	0	0	-29	-1	0	6	
1	1	1	0	0	1	0	0	0	0	
2	-2	0	1	-1	-1	1	1	0	0	
2	-1	10	0	0	-10	10	0	0	-2	
2	0	-1	0	0	0	0	0	0	0	

Table A-5. (Cont.)
 Secular Terms
 c) Earth on Jupiter

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-41164	0	-494368	0	-595	0
1	-993	3979	3979	-1656	8215	156281
2	13658	164598	-164406	13642	198	3769
3	989	11903	-11896	988	7	136
4	64	765	-765	64	0	6
5	4	48	-48	4	0	0
6	0	3	-3	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	87	0	-3	0	-2	0
1	-1804	150	-75	-901	22	427
2	-22	2	-2	-22	1	10
3	0	0	0	-1	0	0
4	0	-1	0	0	0	0

Table A-5. (Cont.)
 Periodic Terms
 d) Mars on Jupiter

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	3	-55718	0	12604	0	1245	0	0	0		
0	4	594271	-1040	1392	594557	0	0	0	0		
0	5	1690	12569	-12577	1694	109	-90	0	0		
1	-5	10	7	7	-10	0	0	0	0		
1	-4	200	139	139	-200	0	0	0	0		
1	-3	-482	-411	-405	473	0	0	0	0		
1	-2	-620	-689	-484	328	3	3	0	0		
1	-1	-902	-2049	-2237	1122	2	8	0	0		
1	0	-842	-6163	-6303	963	-9	35	0	0		
1	1	1697	1636	1463	-1607	-104	93	0	0		
1	2	-360	-152	195	385	-56	-9	0	0		
1	3	380376	302908	-303522	379417	-6091	10432	-2	4		
1	4	-169	33	-33	-168	5	7	0	0		
1	5	-14	-2	3	-14	0	0	0	0		
2	-3	6	-4	-4	-6	0	0	0	0		
2	-2	74	7	7	-74	0	0	0	0		
2	-1	429	392	393	-428	-2	1	0	0		
2	0	634	2875	2877	-628	-9	0	0	0		
2	1	-5	-100	-145	77	0	-7	0	0		
2	2	87	392	-390	90	43	-17	0	0		
2	3	17673	14096	-14114	17641	-283	488	0	0		
2	4	-1	0	0	-1	0	0	0	0		
3	-4	2	0	0	-2	0	0	0	0		
3	-3	10	10	10	-10	0	0	0	0		
3	-2	16	99	99	-16	0	0	0	0		
3	-1	-173	388	387	175	0	0	0	0		
3	0	34	77	62	-30	0	0	0	0		
3	1	-21	40	-48	-18	8	2	0	0		
3	2	3	15	-15	3	2	0	0	0		
3	3	1234	984	-985	1232	-20	34	0	0		
4	-4	0	4	3	0	0	0	0	0		
4	-3	-10	19	19	10	0	0	0	0		
4	-2	-67	37	37	67	0	0	0	0		
4	-1	-7	24	21	5	0	0	0	0		
4	0	-5	6	0	-8	0	1	0	0		
4	1	-1	3	-3	-1	0	0	0	0		
4	3	102	81	-81	102	-2	3	0	0		
5	-4	-5	3	1	5	0	0	0	0		
5	-3	-15	-2	-2	15	0	0	0	0		
5	-2	-6	4	4	5	0	0	0	0		
5	-1	-2	1	2	-1	0	0	0	0		
5	3	9	7	-7	9	0	0	0	0		

Table A-5. (Cont.)
d) Mars on Jupiter

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC				(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	238	0	0	0	50	0
0	1	0	0	-10	10	0	0	-2	2
0	2	0	0	-1	0	0	0	0	0
1	-3	-1	1	0	-1	-1	1	0	0
1	-2	-5	4	7	3	-11	11	2	1
1	-1	-120	150	151	121	-120	150	32	25
1	0	9	-11	0	0	3	-4	-1	-1
2	-2	1	0	1	2	1	0	0	0
2	-1	-6	7	7	6	-6	7	1	1
2	0	0	-1	0	0	0	0	0	0

Table A-5. (Cont.)

Secular Terms

d) Mars on Jupiter

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	58339	0	-61381	0	3329	0
1	1407	494	494	2347	-45951	5834
2	-19356	20436	-20413	-19333	-1108	141
3	-1401	1478	-1477	-1401	-40	5
4	-90	95	-95	-90	-2	0
5	-6	6	-6	-6	0	0

NDZ NU U/COS(1)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	11	0	1	0	9	0
1	-224	-213	106	-112	-126	16
2	-3	-3	3	-2	-3	0
3	1	0	0	0	0	0
12	0	-1	0	0	0	0

Table A-5. (Cont.)
Periodic Terms
e) Saturn on Jupiter

		DX		DY		DZ		U/COS(I)	
		(IN UNITS OF 10**(-12))							
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	9884078	0	-8750368	0	931967	0	369	0
0	1	-60511873	1080078	272001	-61112315	0	0	0	0
0	2	6592898	-4198591	4203294	6616708	-370574	195680	-147	78
0	3	213388	-153943	153398	213644	-12779	-2743	-5	-1
0	4	4612	-7832	7841	4616	-249	-96	0	0
0	5	0	-474	466	8	-12	3	0	0
0	6	1	-39	36	-3	0	0	0	0
0	7	5	4	-3	4	0	0	0	0
0	8	-3	2	-2	-3	0	0	0	0
0	9	0	-1	1	0	0	0	0	0
1	-10	2	1	1	-1	0	0	0	0
1	-9	-4	6	5	3	0	0	0	0
1	-8	-9	32	33	7	0	0	0	0
1	-7	-33	651	655	38	0	0	0	0
1	-6	-913	10653	10639	921	-4	-10	0	0
1	-5	-16783	171860	171805	16759	-35	-191	0	0
1	-4	-309042	2780380	2779267	309070	-1444	-2705	-1	-1
1	-3	-5844897	44714066	44685710	5838297	-102091	-103311	-40	-41
1	-2	-124848480	676179493	675775457	124475835	-1491200	-6535066	-591	-2591
1	-1	115070835	77287991	91605760	-133442572	-1287201	-2928884	-510	-1161
1	0	257994658	-1321400021	1316791236	249713904	-7708801	11265165	-3056	4466
1	1	-73184184	-104749188	104808011	-73064339	747218	2476214	296	982
1	2	-5032387	-4991282	4989625	-5027104	-16410	63398	-7	25
1	3	-323527	-269007	268909	-323400	-251	1645	0	1
1	4	-20222	-15572	15573	-20209	10	87	0	0
1	5	-1256	-938	934	-1255	0	5	0	0
1	6	-72	-59	59	-73	0	0	0	0
1	7	-4	0	1	-4	0	0	0	0
1	8	-1	0	0	-1	0	0	0	0
2	-11	1	-2	-1	-1	0	0	0	0
2	-10	-2	3	2	3	0	0	0	0
2	-9	-97	-33	-35	95	0	0	0	0
2	-8	-1336	-620	-613	1331	0	0	0	0
2	-7	-21116	-9346	-9338	21128	-3	0	0	0
2	-6	-335508	-146459	-146447	335408	-51	-16	0	0
2	-5	-5270920	-2265810	-2264866	5268674	-831	44	0	0
2	-4	-80093640	-33588605	-33570361	80041489	-37322	15758	-15	6
2	-3	-1061345880	-421201595	-420806175	1059814448	-1546722	-27762	-613	-11
2	-2	-1446211280	27902024	35492463	1391300314	4814708	-2735051	1909	-1084
2	-1	3520457884	1530730436	-1486815762	3504940619	11079943	11696940	4393	4637
2	0	1925819778	14364752	-14679648	1924713930	-9422210	-4626645	-3735	-183
2	1	79018610	-9178007	9173919	78999559	-255392	121250	-101	48
2	2	4032038	-599302	598877	4031207	-11148	1745	-4	1
2	3	227512	-37294	37283	222464	-397	23	0	0
2	4	12822	-2322	2321	12823	-17	3	0	0
2	5	758	-150	148	758	0	0	0	0
2	6	48	-9	9	48	0	0	0	0
2	7	3	0	0	3	0	0	0	0
3	-12	-2	-2	-2	1	0	0	0	0
3	-11	7	-2	-1	-6	0	0	0	0
3	-10	-2	25	22	5	0	0	0	0
3	-9	-101	113	109	91	0	0	0	0
3	-8	-950	1769	1792	946	0	2	0	0
3	-7	-13702	28614	28596	13742	-21	26	0	0
3	-6	-184226	439609	439198	184131	-250	574	0	0
3	-5	-2071914	6435427	6426511	2072456	-1417	19775	-1	8
3	-4	-10533737	81509344	81261485	10628152	-100315	519570	-40	206
3	-3	358544648	480138926	476268677	-351694893	-93112	-1054917	-37	-418
3	-2	39450681	-367072966	176617907	371442010	21934470	-13997895	8696	-5547
3	-1	-886305551	-1198153455	1194936711	-886999550	-739194	4786040	-293	1897
3	0	92996024	31306849	-31220984	92891677	1072340	843100	475	344
3	1	5535065	2575079	-2572858	5532820	18925	28342	8	11
3	2	316791	164040	-163976	316685	639	787	0	0
3	3	18528	10056	-10051	18523	36	33	0	0
3	4	1103	614	-615	1104	2	2	0	0
3	5	67	36	-36	67	0	0	0	0
3	6	5	3	-2	5	0	0	0	0

Table A-5. (Cont.)

e) Saturn on Jupiter

4	-13	-3	1	0	3	0	0	0	0
4	-12	-1	-9	-8	0	0	0	0	0
4	-11	24	5	7	-19	0	0	0	0
4	-10	-9	77	64	12	0	0	0	0
4	-9	20	430	432	-51	1	0	0	0
4	-8	1565	6583	6638	-1538	12	24	0	0
4	-7	22831	90215	90132	-22532	319	377	0	0
4	-6	274843	1088038	1089007	-270995	9573	5665	4	2
4	-5	1222623	10054989	10140839	-11101213	188985	93386	75	37
4	-4	-64358490	38858917	42957352	65310295	-230628	363762	-91	144
4	-3	-38950840	101324533	219361889	-76107531	2277714	5787694	403	2295
4	-2	274411779	-135440884	130788623	277048410	3653474	-802905	1448	-318
4	-1	-21784620	-262773057	262624282	-21837662	-695062	1031905	-276	409
4	0	-516154	-9331748	9331999	-516883	10400	71419	4	28
4	1	-3746	-428006	427935	-3708	-685	2221	0	1
4	2	-189	-22588	22586	-191	-22	64	0	0
4	3	-16	-1274	1274	-15	0	3	0	0
4	4	-2	-75	75	-2	0	0	0	0
4	5	0	-5	5	0	0	0	0	0
5	-15	1	0	0	0	0	0	0	0
5	-14	0	4	4	0	0	0	0	0
5	-13	-12	-1	-2	10	0	0	0	0
5	-12	11	-29	-23	-12	0	0	0	0
5	-11	70	36	36	-52	0	0	0	0
5	-10	141	124	85	-153	1	0	0	0
5	-9	2949	376	474	-3016	20	-2	0	0
5	-8	41488	5849	6142	-41368	314	-126	0	0
5	-7	516790	90118	94475	-517204	4603	-6050	0	-2
5	-6	5712866	1926635	2012657	-5768554	55098	-68735	21	-27
5	-5	58076200	46253170	46977873	-60250580	117958	56768	47	72
5	-4	706950538	692712105	66582349	-749561613	1315349	-2376320	521	-942
5	-3	-5304861670	17581095209	12682085782	5319226608	8840677	-91977644	3505	-36444
5	-2	-2915057134	-225364594	223898270	-2913116667	-473389	7086244	-130	2809
5	-1	5124674756	-12417070734	17409712103	5121566133	4108331	-1751135	1629	-694
5	0	250252662	-603928630	603692062	250153350	99386	-38354	39	-15
5	1	13634304	-32455005	32845367	13630272	3529	-1440	1	-1
5	2	780878	-1880455	1880014	780694	153	-64	0	0
5	3	46025	-110792	110771	46016	7	-3	0	0
5	4	2763	-6652	6651	2763	0	0	0	0
5	5	168	-405	405	168	0	0	0	0
5	6	10	-25	25	10	0	0	0	0
5	7	0	-2	2	0	0	0	0	0
6	-16	0	-1	-1	0	0	0	0	0
6	-15	6	1	1	-3	0	0	0	0
6	-14	-5	14	12	5	0	0	0	0
6	-13	-33	-21	-21	26	0	0	0	0
6	-12	62	-66	-65	-56	0	0	0	0
6	-11	113	69	63	-66	0	-1	0	0
6	-10	41	-60	-708	-125	4	-14	0	0
6	-9	1576	-8889	-8666	-1843	-10	-219	0	0
6	-8	6028	-82666	-82481	-9298	-1275	-3001	-1	-1
6	-7	3591	-457705	-487717	-64751	-21267	-27768	-8	-11
6	-6	1535479	1040069	-57427	-7101587	72402	-36053	29	-14
6	-5	1982929	15476627	-1622768	3612347	53767	-307424	21	-122
6	-4	-3931018	11316186	8849476	-33137232	1115807	351205	442	189
6	-3	6947562	-29411232	31784668	9446911	442864	-815453	176	-323
6	-2	-29012613	-20958573	20932358	-29006264	36554	185000	14	73
6	-1	-380666	-1348659	1348065	-381490	17715	5609	7	2
6	0	-3738	-75220	75204	-3742	333	423	0	0
6	1	80	-4064	4063	80	9	9	0	0
6	2	11	-234	234	11	0	0	0	0
6	3	0	-14	14	0	0	0	0	0
6	4	0	-1	1	0	0	0	0	0
6	16	-4	3	3	4	0	0	0	0
7	-16	1	-7	-4	-2	0	0	0	0
7	-15	23	9	10	-7	0	0	0	0
7	-14	-35	36	28	34	0	0	0	0
7	-13	-64	-98	-86	40	0	0	0	0
7	-12	177	-181	-45	-129	-1	0	0	0
7	-11	-111	120	-13	263	0	-6	0	0
7	-10	-3318	-1401	-1615	2990	-134	-34	0	0
7	-9	-26732	-8404	-10534	26136	-1742	213	-1	0
7	-8	-127365	-21319	-62352	139700	-13765	5918	-5	2
7	-7	410290	-234145	-626188	93342	-9881	-37219	-4	-15
7	-6	4014200	726136	1313501	2804694	-94279	-39009	-37	-15
7	-5	-6659158	13777040	-331966	5586533	185064	-247652	73	-98
7	-4	-689373	11525326	18671804	-15345984	920018	92588	368	379
7	-3	20909801	-20913870	20983788	21027689	48745	-125844	19	-80
7	-2	-8604619	-19707575	19697354	-8601081	-20362	66517	-8	26
7	-1	-358096	-862154	861879	-358009	329	2126	0	1
7	0	-17827	-45181	45169	-17821	-14	83	0	0
7	1	-989	-2523	2523	-989	0	3	0	0
7	2	-57	-146	147	-57	0	0	0	0
7	3	-4	-9	9	-4	0	0	0	0
7	16	-21	2	2	21	0	0	0	0
8	-16	17	-23	-8	-15	0	2	0	0
8	-15	62	65	41	0	0	0	0	0
8	-14	-144	55	26	126	0	0	0	0
8	-13	-57	-285	-209	2	0	2	0	0
8	-12	336	79	152	-137	-7	5	0	0
8	-11	-894	1491	1039	1025	-44	73	0	0
8	-10	-5285	8486	7806	6382	-138	925	0	0
8	-9	-11045	33903	36917	37054	954	6444	0	3
8	-8	-671	-189507	24986	249609	-18771	1005	-7	0
8	-7	441645	-1547337	1153414	-31533	-27046	28667	-9	11
8	-6	3376292	1566950	-357374	2230329	-78846	-81186	-31	-32
8	-5	1021750	1972528	-342822	-5019410	157850	-105588	63	-62
8	-4	-2145594	-1771980	4409990	-2039920	-98145	-275589	-39	-109
8	-3	-7421610	1820351	-1825220	-7419543	28698	24020	11	10
8	-2	-214462	-304880	904114	-214504	5500	-4749	2	-2
8	-1	-9441	-51760	51739	-9441	170	-37	0	0
8	0	-448	-2934	2933	-448	4	-2	0	0
8	1	-25	-171	171	-25	0	0	0	0
8	2	-3	-10	10	-1	0	0	0	0
8	15	-3	2	2	3	0	0	0	0
8	16	-83	-34	-34	83	0	0	0	0

Table A-5. (Cont.)
e) Saturn on Jupiter

9	-16	96	-48	3	-57	-5	5	0	0
9	-15	96	288	89	69	0	-1	0	0
9	-14	-401	-17	-79	299	3	0	0	0
9	-13	167	-562	-278	-207	2	7	0	0
9	-12	1019	669	671	-417	34	37	0	0
9	-11	2511	2958	3190	-2028	453	198	0	0
9	-10	8082	3075	18787	-8101	2864	360	1	0
9	-9	-76887	-38850	108898	-4335	-1459	9168	-1	4
9	-8	-568116	-294445	138687	-470960	7615	10647	3	4
9	-7	874247	-1129418	1094025	581009	-38755	24162	-15	10
9	-6	1066677	1620212	-598728	905159	-18644	-61503	-7	-24
9	-5	-335696	774255	-313365	-2020735	116201	-9506	46	-4
9	-4	-168686	-2027867	2072270	-146993	-7385	-24714	-1	-10
9	-3	-1345897	-476885	426401	-1345111	3731	6178	1	2
9	-2	-48740	-25543	25528	-48737	355	70	0	0
9	-1	-2791	-1545	1545	-2291	9	9	0	0
9	0	-121	-87	87	-121	0	0	0	0
9	1	-7	-5	5	-7	0	0	0	0
9	15	-14	0	0	14	0	0	0	0
9	16	-222	-272	-272	221	3	1	0	0
10	-16	372	-10	102	-131	-19	5	0	0
10	-15	-88	912	17	272	0	-4	0	0
10	-14	-784	-386	-414	407	8	0	0	0
10	-13	799	-1027	-251	-595	26	-11	0	0
10	-12	1866	-348	-311	-1407	161	-202	0	0
10	-11	-175	-2348	-523	-9133	513	-1181	0	0
10	-10	-32587	27423	3182	-50420	4298	1686	2	1
10	-9	-173268	199612	-178438	-113085	4586	-1297	2	-1
10	-8	-418834	-491269	382200	-429402	6378	18502	3	7
10	-7	805170	-480492	213807	414865	-27294	2468	-11	1
10	-6	1983942	-1282277	-2388952	-1723471	-4760	-32916	-2	-13
10	-5	12941842	12926513	13127599	-13827444	-377257	-150988	-150	-60
10	-4	-3584630	7179933	-7191710	-3590785	30141	9242	12	4
10	-3	-13029873	-12336216	12328727	-13022001	18	-11727	0	-5
10	-2	-640213	-605308	605068	-639960	20	-278	0	0
10	-1	-34935	-33034	33024	-34925	0	-10	0	0
10	0	-2003	-1893	1893	-2002	0	0	0	0
10	1	-118	-112	112	-118	0	0	0	0
10	2	-7	-7	7	-7	0	0	0	0
10	14	-2	0	0	2	0	0	0	0
10	15	-51	-17	-17	51	0	0	0	0
10	16	-237	-1212	-1213	235	6	7	0	0
11	-16	1054	443	396	-81	-48	-11	0	0
11	-15	-1188	2140	-654	362	2	-9	0	0
11	-14	-1196	-1210	-850	175	2	-15	0	0
11	-13	800	-1479	-506	-138	-80	-107	0	0
11	-12	-462	1259	-4610	-1000	-440	-376	0	0
11	-11	7457	20557	-23962	-5194	1290	-1911	1	-1
11	-10	63724	92262	-68256	60327	265	-1724	0	-1
11	-9	-259279	146291	-150249	-227930	8613	-874	3	0
11	-8	-94352	-346494	311854	-113376	-1437	12304	-1	5
11	-7	316508	15073	29527	-239756	-11051	-4517	-4	-2
11	-6	23980	135355	-737433	-130383	7901	-11042	3	-4
11	-5	-159732	-109846	128818	-166249	-4207	-3957	-2	-2
11	-4	-156629	97748	-97786	-156560	1053	745	0	0
11	-3	-7461	-1527	1522	-7458	61	-72	0	0
11	-2	-397	-173	173	-397	3	0	0	0
11	-1	-21	-11	11	-21	0	0	0	0
11	0	-1	0	0	-1	0	0	0	0
11	13	0	-1	-1	0	0	0	0	0
11	14	-9	0	0	9	0	0	0	0
11	15	-139	-125	-125	139	0	0	0	0
11	16	1149	-3751	-3750	-1156	6	28	0	0
12	-16	2158	2296	539	638	-92	-61	0	0
12	-15	-4390	3681	-2341	-999	-6	-10	0	0
12	-14	-1493	-1763	-425	-139	-61	26	0	0
12	-13	1841	-216	-1026	2767	-221	138	0	0
12	-12	11583	-110	-5135	11317	-789	-840	0	0
12	-11	45416	-15861	16448	36014	-509	-434	0	0
12	-10	40534	134605	-123115	44472	534	-3861	0	-2
12	-9	-178482	12152	-19706	-167818	5598	1940	2	1
12	-8	33941	-143455	138886	17399	-3121	4640	-1	2
12	-7	108492	89655	3281	58806	-7823	-3609	-1	-1
12	-6	54452	38220	-53248	-145611	9811	-4957	4	-2
12	-5	-69206	-161534	162839	-69181	-779	-360	0	0
12	-4	-126386	4324	-4330	-126326	301	252	0	0
12	-3	-5497	-6	6	-5495	11	3	0	0
12	-2	-287	-7	7	-287	0	0	0	0
12	-1	-16	0	0	-16	0	0	0	0
12	12	0	-2	-2	0	0	0	0	0
12	13	5	-2	-2	5	0	0	0	0
12	14	-28	-14	-13	28	0	0	0	0
12	15	-273	-559	-559	273	0	2	0	0
12	16	7282	-7974	-7960	-7303	-21	70	0	0

Table A-5. (Cont.)
e) Saturn on Jupiter

13	-16	3265	6842	-1230	2769	-90	-64	0	0
13	-15	-9816	3424	-2752	-5966	6	29	0	0
13	-14	-929	-2570	2161	448	30	111	0	0
13	-13	2357	-6180	4954	4679	-494	292	0	0
13	-12	-932	-20759	17007	-1755	-293	59	0	0
13	-11	67158	-4244	6759	63064	-1643	-663	-1	0
13	-10	-12888	90058	-86511	-9085	1529	-2470	1	-1
13	-9	-71623	-31358	26384	-69546	1945	2016	1	1
13	-8	35395	-40667	36867	26930	-1867	991	-1	0
13	-7	18614	8919	-39975	13911	-447	-1734	0	-1
13	-6	-16561	7771	-2564	-28356	-1728	64	-1	0
13	-5	-5676	37730	-37751	-5469	189	-100	0	0
13	-4	-4433	-534	582	-4429	-9	-33	0	0
13	-3	-254	-44	44	-254	0	0	0	0
13	-2	-14	-3	3	-14	0	0	0	0
13	-1	-2	0	0	2	0	0	0	0
13	0	1	-9	-9	-1	0	0	0	0
13	1	21	5	5	-21	0	0	0	0
13	14	-85	-62	-61	85	0	-2	0	0
13	15	-389	-1693	-1692	389	0	5	0	0
13	16	21241	-7921	-7857	-21284	-107	116	0	0
14	-16	808	11864	-5730	2245	105	-64	0	0
14	-15	-17699	-2178	3470	-16026	49	-4	0	0
14	-14	-4104	-3665	4793	-2301	92	266	0	0
14	-13	-8568	-2552	2171	-6834	-67	148	0	0
14	-12	5817	-32093	30768	4475	-482	649	0	0
14	-11	43965	16267	-14401	42838	-1029	-1015	0	0
14	-10	-24195	34299	-33802	-22291	1235	-763	0	0
14	-9	-17276	-22196	20171	-17698	300	1034	0	0
14	-8	17164	-5148	6522	11351	-726	-10	0	0
14	-7	3449	5181	-12713	-2226	214	-836	0	0
14	-6	-11126	-3386	3612	-11325	-135	-20	0	0
14	-5	-4780	5804	-5803	-4777	39	-6	0	0
14	-4	-228	185	-185	-228	1	-2	0	0
14	-3	-13	8	-8	-13	0	0	0	0
14	-2	0	3	3	0	0	0	0	0
14	-1	-10	-4	-4	10	0	0	0	0
14	0	21	-29	-29	-21	0	1	0	0
14	1	54	62	62	-54	-3	-2	0	0
14	2	-148	-134	-133	149	4	-4	0	0
14	3	823	-2996	-2993	-821	0	10	0	0
14	4	44499	7275	7431	-44512	-192	111	0	0
15	-16	-15333	24087	-20879	-15261	-14	-119	0	0
15	-15	-21333	-1230	3893	-21683	129	-29	0	0
15	-14	-3612	2361	-1125	-3593	58	75	0	0
15	-13	-14546	-7068	6485	-14254	228	288	0	0
15	-12	13076	-20647	20346	12158	-613	387	0	0
15	-11	15498	16717	-15902	15445	-255	-724	0	0
15	-10	-14136	7091	-7367	-13391	576	-42	0	0
15	-9	-1784	-9478	7549	-1494	-78	358	0	0
15	-8	-210	-7578	-8687	9107	-247	-85	0	0
15	-7	37864	-15289	-20098	-40758	-1090	1262	0	1
15	-6	18772	21178	-21240	18805	75	-109	0	0
15	-5	-36635	17449	-17438	-36612	-37	-15	0	0
15	-4	-1814	871	-871	-1814	0	0	0	0
15	-3	-99	48	-48	-99	0	0	0	0
15	-2	-6	3	-3	-6	0	0	0	0
15	-1	3	0	0	-3	0	0	0	0
15	0	-7	11	11	7	0	0	0	0
15	1	-29	-34	-34	30	1	0	0	0
15	2	119	-53	-54	-119	-3	3	0	0
15	3	72	241	242	-73	-5	-8	0	0
15	4	43	-565	-561	-41	13	-4	0	0
15	5	6885	-7526	-7517	-6887	-1	12	0	0
15	6	53875	9138	9514	-53714	-149	-13	0	0
16	-16	-1934	43199	-42355	-5703	-159	-402	0	0
16	-15	-5265	4508	-4600	-6696	46	-25	0	0
16	-14	-6432	5943	-6018	-6329	152	-66	0	0
16	-13	-9396	-8952	8490	-9370	118	345	0	0
16	-12	10678	-6337	6377	10321	-407	49	0	0
16	-11	2951	8722	-8461	2479	44	-316	0	0
16	-10	-5146	-153	-47	-4970	182	81	0	0
16	-9	989	-2540	2234	588	-76	87	0	0
16	-8	933	301	-1243	1128	-54	-29	0	0
16	-7	-914	611	-606	-1019	-27	15	0	0
16	-6	166	934	-934	166	3	-5	0	0
16	-5	-22	33	-33	-22	0	0	0	0
16	-4	-2	2	-2	-2	0	0	0	0
16	-3	1	-3	-3	-1	0	0	0	0
16	-2	11	10	10	-11	0	0	0	0
16	-1	-50	28	28	50	1	-2	0	0
16	0	-36	-171	-171	37	4	5	0	0
16	1	409	21	19	-411	-13	5	0	0
16	2	-209	563	568	207	-2	-22	0	0
16	3	-565	-1572	-1577	569	22	2	0	0
16	4	2148	-14881	-14929	-2175	-3	14	0	0
16	5	17786	-7461	-7071	-17727	-35	166	0	0

Table A-5. (Cont.)
e) Saturn on Jupiter

J	K	ND7		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)				(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	171	0	-8752	0	0	0	-1838	0
0	1	-1	1483	6835	-1601	0	0	1593	-338
0	2	200	-327	483	384	370	-397	111	90
0	3	21	15	-3	46	55	-11	2	12
0	4	2	1	-1	5	7	1	0	1
0	5	0	0	0	0	1	0	0	0
1	-6	0	0	0	0	1	0	0	0
1	-5	0	-1	-2	0	13	-1	0	-2
1	-4	4	-11	-14	-12	208	3	-1	-29
1	-3	362	-115	-108	-429	3337	195	19	-452
1	-2	13853	-2494	-1177	-10444	52091	4634	498	-6272
1	-1	789754	153190	49483	-256082	792518	148998	10004	-54069
1	0	43789	-84359	17913	5091	81897	-77087	2982	5088
1	1	-904	-2897	2246	-665	3522	-6528	845	374
1	2	75	-89	130	72	292	-465	70	46
1	3	3	-5	11	8	24	-36	6	4
1	4	0	0	1	1	2	-3	0	0
2	-7	0	0	0	0	-1	2	0	0
2	-6	-1	1	2	2	-15	30	5	2
2	-5	-16	21	42	29	-216	462	68	32
2	-4	-393	588	954	563	-3296	7226	1016	471
2	-3	-14156	24867	26604	13981	-51017	114959	15150	6815
2	-2	-766576	1792371	1007658	430870	-766985	1853179	218309	90409
2	-1	45683	1235977	182371	9311	9233	1321922	29234	-1991
2	0	13547	-13123	6898	6776	13484	51695	-5477	1371
2	1	79	-527	696	176	807	2711	-283	108
2	2	-1	-16	52	4	48	141	-15	7
2	3	0	-1	4	0	3	7	-1	0
3	-7	0	0	1	0	3	2	0	0
3	-6	1	6	10	-4	43	32	5	-6
3	-5	40	123	169	-97	678	453	73	-100
3	-4	2504	3482	3476	-3133	11030	6242	992	-1597
3	-3	137561	87156	60136	-97908	169254	63447	10140	-23920
3	-2	659232	-502145	-209564	-282540	662162	-491868	-43932	-58398
3	-1	-80333	124685	-21384	-19102	-48076	100774	-1985	-643
3	0	-4282	757	-338	-6109	-6344	5294	-519	-1461
3	1	-98	10	-12	-479	-678	316	-39	-148
3	2	-3	1	-1	-36	-62	20	-3	-13
3	3	0	0	0	-3	-5	1	0	-1
4	-8	0	0	0	0	1	0	0	0
4	-7	3	1	1	-5	17	-2	0	-3
4	-6	65	12	-2	-94	239	-48	-7	-40
4	-5	1586	-349	-542	-1698	3174	-1074	-181	-527
4	-4	27919	-22862	-17426	-22552	31648	-16369	-2983	-5134
4	-3	65520	136733	82821	-41719	74780	134515	17433	-9479
4	-2	164457	-23434	-2630	-39990	167514	-16779	-1278	-8062
4	-1	-3050	135	1579	-1069	5072	-588	401	634
4	0	-50	-18	181	7	314	-152	50	49
4	1	0	-1	14	3	23	-18	4	4
4	2	0	0	1	0	2	-2	0	0
5	-9	0	0	0	0	0	-1	0	0
5	-8	1	-1	-3	-2	2	-8	-1	0
5	-7	18	-33	-47	-15	18	-117	-20	-3
5	-6	29	-723	-794	36	-5	-1514	-258	4
5	-5	-5063	-10006	-8858	4081	-1648	-14953	-2448	432
5	-4	26868	-24513	-23270	-19705	60967	-87414	-11159	-8396
5	-3	113076	-1548259	-767068	-56817	593654	-1346082	-139979	-62251
5	-2	9934974	4216139	-56121	87890	9940702	4141504	-3934	19071
5	-1	3883	2760	-1400	1929	483475	201639	-21124	50873
5	0	45	30	-30	46	29144	12141	-1530	3680
5	1	1	1	-1	2	1827	761	-105	251
5	2	0	0	0	0	116	48	-7	17
5	3	0	0	0	0	7	3	0	1

Table A-5. (Cont.)
e) Saturn on Jupiter

6	-9	-1	-1	-1	1	-3	-2	0	1
6	-8	-15	-15	-15	22	-41	-18	-4	7
6	-7	-318	-93	-74	348	-491	-69	-13	91
6	-6	-3601	989	780	3207	-3567	601	125	668
6	-5	51	-8141	-6513	55	644	-7923	-1360	-87
6	-4	15089	4290	2602	-9996	15559	3168	509	-2158
6	-3	11081	-17014	-3978	-2990	11874	-16776	-849	-558
6	-2	427	1007	-51	23	1063	114	86	75
6	-1	-5	14	16	-15	50	-6	6	4
6	0	0	0	2	-1	2	-2	1	0
7	-10	-1	0	0	1	-1	1	0	0
7	-9	-10	6	9	12	-15	17	3	3
7	-8	-79	139	154	76	-86	205	39	17
7	-7	52	1400	1281	1	-95	1374	265	14
7	-6	-2992	-601	-441	2602	-2927	-626	-112	538
7	-5	1603	-2680	-2144	-760	1728	-2445	-413	-214
7	-4	8673	9177	2696	-2216	9236	8618	547	-506
7	-3	12864	-7064	-2011	1578	13456	-6475	-493	406
7	-2	-70	38	-88	190	742	-202	5	129
7	-1	-3	0	-4	14	51	-11	1	10
7	0	0	0	0	1	4	-1	0	1
8	-11	0	0	1	0	0	1	0	0
8	-10	2	7	8	-3	7	10	2	-1
8	-9	57	54	54	-64	82	62	12	-16
8	-8	541	110	124	-501	517	166	31	-102
8	-7	-510	1150	1029	434	-529	1110	211	99
8	-6	-1057	-927	-693	901	-1013	-911	-157	180
8	-5	1488	-960	-501	-922	1415	-1055	-111	-197
8	-4	-922	-3196	410	-53	-812	-3255	92	-7
8	-3	962	191	-215	333	898	-70	-13	62
8	-2	-1	20	-28	12	50	23	-5	8
8	-1	0	1	-3	0	3	4	-1	1
9	-11	4	-1	-1	-5	6	-2	0	-1
9	-10	32	-22	-24	-33	39	-30	-6	-8
9	-9	98	-203	-188	-102	120	-187	-38	-23
9	-8	443	326	293	-408	474	334	64	-83
9	-7	-492	379	357	405	-474	381	71	88
9	-6	-143	-423	-268	145	-143	-404	-59	25
9	-5	833	-37	-2	-273	825	-80	1	-59
9	-4	172	-768	226	74	229	-772	48	22
9	-3	4	16	17	10	22	-42	10	4
9	-2	0	0	2	0	1	-4	1	0
10	-12	0	-3	-3	0	-1	-4	-1	0
10	-11	-7	-18	-19	8	-10	-22	-4	2
10	-10	-72	-61	-63	66	-63	-69	-14	13
10	-9	188	-164	-154	-174	191	-154	-31	-38
10	-8	126	263	228	-127	129	254	49	-25
10	-7	-210	19	29	143	-186	12	3	30
10	-6	69	-454	-189	-255	103	-384	-38	-52
10	-5	-2077	-988	1628	-1016	-2063	-1036	341	-216
10	-4	10474	-10546	10144	10155	10199	-10683	2157	2103
10	-3	12	-13	733	732	980	-1009	259	254
10	-2	0	0	53	53	88	-90	21	21
10	-1	0	0	4	4	7	-7	2	2
10	0	0	0	0	0	1	-1	0	0
11	-16	-1	0	0	1	-1	0	0	0
11	-13	-2	0	-1	1	-2	0	0	0
11	-12	-10	1	2	10	-12	2	0	2
11	-11	-33	22	20	34	-36	17	4	7
11	-10	-55	-102	-96	52	-50	-102	-20	10
11	-9	138	-33	-37	-125	135	-34	-7	-27
11	-8	-7	107	91	-3	-2	104	19	0
11	-7	-58	-25	-9	41	-57	-21	-3	8
11	-6	49	-61	-22	-20	44	-64	-5	-5
11	-5	-55	-77	20	-12	-52	-81	5	-2
11	-4	7	0	4	3	3	-7	2	0
11	-3	0	0	0	0	0	-1	0	0
11	17	-1	0	0	-1	-1	0	0	0

Table A-5. (Cont.)
e) Saturn on Jupiter

12	-17	0	1	1	0	0	0	0	0
12	-16	-1	-1	-1	1	-1	-1	0	0
12	-15	1	-1	0	0	1	-1	0	0
12	-14	0	2	1	0	0	2	0	0
12	-13	-1	5	5	0	-1	6	1	0
12	-12	5	16	17	-4	2	17	4	-1
12	-11	-53	14	14	90	-53	12	2	11
12	-10	-2	-71	-66	4	-2	-70	-14	0
12	-9	54	15	9	-49	53	12	2	-10
12	-8	-18	27	23	11	-16	28	5	3
12	-7	-10	-15	-3	6	-8	-15	-1	1
12	-6	75	-32	-2	-13	74	-36	-1	-3
12	-5	-3	-90	33	2	2	-92	7	1
12	-4	1	0	3	1	1	-7	1	0
12	-3	0	0	0	0	0	-1	0	0
12	17	-3	-3	3	-3	-3	-3	1	-1
13	-17	-2	1	1	2	-2	1	0	0
13	-16	-1	-3	-3	1	-1	-3	-1	0
13	-15	2	0	0	0	2	0	0	0
13	-14	2	2	1	-2	3	0	0	-1
13	-13	7	0	0	-8	7	2	0	-2
13	-12	1	26	25	-1	-1	26	5	0
13	-11	-36	-7	-5	34	-35	-7	-1	7
13	-10	14	-27	-25	-10	12	-26	-5	-2
13	-9	13	13	9	-12	13	11	2	-2
13	-8	-8	4	4	5	-8	4	1	1
13	-7	-2	-9	-4	0	-3	-9	-1	0
13	-6	-21	-2	1	-5	-21	-3	0	-1
13	-5	3	-5	3	1	1	-5	1	0
13	16	0	1	0	-1	-1	0	0	0
13	17	-3	-8	8	-3	-3	-8	2	-1
13	18	0	0	0	0	0	-1	0	0
14	-17	-3	0	0	3	-3	0	0	1
14	-16	1	-7	-7	-1	1	-7	-1	0
14	-15	3	-1	-2	-1	3	-1	0	0
14	-14	1	-3	-3	-1	2	-2	-1	0
14	-13	13	3	2	-12	12	4	1	-2
14	-12	-7	17	16	7	-7	17	3	2
14	-11	-13	-10	-9	12	-13	-10	-2	3
14	-10	8	-6	-6	-7	8	-6	-1	-1
14	-9	1	5	4	-2	2	5	1	0
14	-8	-3	0	0	1	-3	0	0	0
14	-7	2	-5	-1	0	1	-5	0	0
14	-6	-4	-3	1	-1	-4	-3	0	0
14	16	-1	1	0	-1	-1	0	0	0
14	17	3	-18	18	3	3	-18	4	1
14	18	0	0	1	0	0	-1	0	0
15	-18	0	0	0	0	-1	0	0	0
15	-17	-9	-6	-6	9	-9	-7	-1	2
15	-16	2	-8	-9	-1	1	-8	-2	0
15	-15	0	-1	-2	1	0	-2	0	0
15	-14	3	-6	-5	-3	4	-5	-1	-1
15	-13	8	6	5	-8	8	6	1	-2
15	-12	-7	6	6	6	-7	6	1	1
15	-11	-2	-5	-5	2	-2	-5	-1	0
15	-10	3	0	-1	-2	3	0	0	-1
15	-9	0	1	1	0	0	1	0	0
15	-8	-1	0	-1	1	-2	0	0	0
15	-7	-14	10	-3	-6	-15	9	-1	-1
15	-6	-23	-54	36	-16	-24	-53	7	-3
15	-5	-1	-2	3	-2	-3	-7	1	0
15	-4	0	0	0	0	0	-1	0	0
15	16	-3	-1	3	-3	-3	-2	0	-1
15	17	4	-21	21	4	3	-21	5	1
15	18	0	-1	1	0	0	-2	0	0
16	-18	0	0	0	1	-1	0	0	0
16	-17	-17	-2	-2	17	-17	-2	0	4
16	-16	-1	-2	-3	2	-2	-3	-1	0
16	-15	-2	-3	-2	2	-2	-3	0	0
16	-14	4	-4	-3	-4	4	-4	-1	-1
16	-13	2	4	4	-2	2	4	1	0
16	-12	-3	1	1	3	-3	1	0	1
16	-11	0	-2	-2	0	0	-2	0	0
16	-10	1	0	0	-1	1	0	0	0
16	-7	-1	0	0	0	-1	0	0	0
16	15	0	0	0	-1	0	0	0	0
16	16	-6	0	1	-6	-6	-1	0	-1
16	17	-3	-7	7	-3	-3	-7	1	-1
16	18	0	0	0	0	0	-1	0	0

Table A-5. (Cont.)
 Secular Terms
 e) Saturn on Jupiter

J	DX		DY		DZ	
	(IN UNITS OF $10^{**}(-16)$)		(IN UNITS OF $10^{**}(-16)$)		(IN UNITS OF $10^{**}(-16)$)	
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)		(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)		(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)	
	COS	SIN	COS	SIN	COS	SIN
0	-278771242	0	-313267738	0	-3326362	0
1	-6723968	2522170	2520535	-11214868	45916343	-104009693
2	92491329	104301143	-104179501	92383040	1107067	-2508215
3	6696557	7542798	-7538397	6692641	40040	-90725
4	430721	484962	-484773	430553	1716	-3889
5	27051	30451	-30442	27043	81	-183
6	1691	1903	-1903	1690	4	-9
7	106	119	-119	106	0	0
8	7	7	-7	7	0	0

NDZ
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	NDZ		NU		U/COS(I)	
	(IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T		(IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T		(IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T	
	(WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)		(WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)		(WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)	
	COS	SIN	COS	SIN	COS	SIN
0	55169	0	-12289	0	-9093	0
1	-1142851	1017595	-508798	-571425	125523	-284334
2	-13780	12267	-12267	-13780	3026	-6857
3	-332	296	-444	-498	109	-248
4	-11	9	-19	-22	5	-11
5	0	1	-1	-1	0	-1

Table A-5. (Cont.)
Periodic Terms
f) Uranus on Jupiter

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	178428	0	-10103	0	-8247	0	-3	0		
0	1	-841454	2494	539	-835718	0	0	0	0		
0	2	97802	-10107	10085	97804	1485	453	1	0		
0	3	3672	-524	523	3672	40	16	0	0		
0	4	134	-30	30	134	2	0	0	0		
0	5	5	-2	2	5	0	0	0	0		
1	-7	6	2	2	-6	0	0	0	0		
1	-6	91	32	32	-91	0	0	0	0		
1	-5	1488	538	538	-1487	0	0	0	0		
1	-4	24294	9031	9028	-24285	12	0	0	0		
1	-3	394489	152827	152737	-394271	331	-32	0	0		
1	-2	6012226	2501130	2497503	-6005431	14605	-582	6	0		
1	-1	4064105	587523	291302	-3685466	51568	-4317	20	-2		
1	0	-14902544	-6414324	6394548	-15249010	-28424	-27408	-11	-11		
1	1	-3868822	-597346	597400	-3863461	-33314	-22863	-13	-9		
1	2	-242914	-26109	26101	-242773	-703	-518	0	0		
1	3	-14490	-1374	1374	-14485	-27	-19	0	0		
1	4	-868	-78	78	-868	-1	0	0	0		
1	5	-53	-5	5	-53	0	0	0	0		
1	6	-3	0	0	-3	0	0	0	0		
2	-8	3	3	3	-3	0	0	0	0		
2	-7	40	44	44	-40	0	0	0	0		
2	-6	605	668	668	-605	0	0	0	0		
2	-5	8973	9833	9830	-8969	-2	0	0	0		
2	-4	124908	135303	135257	-124842	-50	-13	0	0		
2	-3	1428617	1516179	1515966	-1427541	-1322	-384	-1	0		
2	-2	2951780	2754439	2806854	-2964468	5567	5886	2	2		
2	-1	-6256442	-6952949	7106726	-6744983	61852	189618	25	75		
2	0	-6912603	-6566449	6564808	-6922732	-11295	-27211	-4	-11		
2	1	-422328	-283575	283506	-422037	-1938	-2389	-1	-1		
2	2	-22095	-13317	13314	-22087	-41	-59	0	0		
2	3	-1251	-717	717	-1251	-2	-2	0	0		
2	4	-73	-41	41	-73	0	0	0	0		
2	5	-4	-2	2	-4	0	0	0	0		
3	-8	0	-4	-4	0	0	0	0	0		
3	-7	-10	-54	-54	10	0	0	0	0		
3	-6	-120	-684	-685	120	0	0	0	0		
3	-5	-990	-7210	-7245	990	10	12	0	0		
3	-4	4032	-41631	-42746	-3927	161	199	0	0		
3	-3	407026	545226	506176	-399367	-561	389	0	0		
3	-2	816625	1391249	-198915	-259383	-1403	22560	-1	9		
3	-1	-1739917	-2305984	2325867	-1780406	6974	28533	3	11		
3	0	-1113871	-1249298	1248953	-1114053	-1540	-4998	-1	-2		
3	1	-53330	-51398	51383	-53305	-139	-260	0	0		
3	2	-2689	-2484	2484	-2689	-3	-7	0	0		
3	3	-150	-135	135	-150	0	0	0	0		
3	4	-9	-8	8	-9	0	0	0	0		
4	-8	-2	9	9	2	0	0	0	0		
4	-7	-18	99	100	19	0	0	0	0		
4	-6	-167	932	951	174	-1	-4	0	0		
4	-5	-1012	4950	5404	1148	-11	-43	0	0		
4	-4	-256	-28846	-18114	2498	120	14	0	0		
4	-3	96813	29461	252780	-77055	856	-1578	0	-1		
4	-2	164460	411810	-176642	-18231	-1639	9137	-1	4		
4	-1	-347423	-569118	571600	-351225	611	3171	0	1		
4	0	-165435	-217007	216935	-165399	-166	-777	0	0		
4	1	-7359	-8936	8933	-7356	-10	-30	0	0		
4	2	-373	-444	444	-373	0	0	0	0		
4	3	-21	-24	24	-21	0	0	0	0		
4	4	-1	-1	1	-1	0	0	0	0		
5	-9	0	-1	-1	0	0	0	0	0		
5	-8	9	-13	-13	-9	0	0	0	0		
5	-7	72	-100	-106	-78	0	0	0	0		
5	-6	303	-334	-459	-407	-2	8	0	0		
5	-5	-1523	4225	1947	-94	-24	-13	0	0		
5	-4	-8680	9348	-21744	-8952	-206	176	0	0		
5	-3	26662	-12519	86806	-9147	491	-699	0	0		
5	-2	28206	96949	-43471	-7291	-757	2685	0	1		
5	-1	-64760	-135485	135814	-65166	66	260	0	0		
5	0	-27623	-42814	42798	-27612	-15	-123	0	0		
5	1	-1217	-1811	1810	-1216	0	-4	0	0		
5	2	-63	-93	93	-63	0	0	0	0		
5	3	-4	-5	5	-4	0	0	0	0		

Table A-5. (Cont.)
f) Uranus on Jupiter

6	-9	-2	1	1	2	0	0	0	0
6	-8	-15	9	10	18	0	0	0	0
6	-7	-35	10	33	81	1	-1	0	0
6	-6	557	-498	-144	38	4	5	0	0
6	-5	2230	-850	2750	2808	43	-15	0	0
6	-4	-5289	7165	-9271	-5791	-129	83	0	0
6	-3	7929	-1176	25112	-730	156	-179	0	0
6	-2	6214	23681	-3999	-4782	-320	830	0	0
6	-1	-13825	-38908	38962	-13881	19	-7	0	0
6	0	-7130	-13208	13202	-7126	0	-24	0	0
6	1	-323	-586	586	-323	0	0	0	0
6	2	-17	-31	31	-17	0	0	0	0
6	3	0	-2	2	0	0	0	0	0
7	-9	3	0	0	-4	0	0	0	0
7	-8	0	2	1	-15	0	0	0	0
7	-7	-139	38	19	-29	0	-1	0	0
7	-6	-447	-4	-200	-652	-8	0	0	0
7	-5	1727	-763	1449	1833	30	-5	0	0
7	-4	-1316	4228	-600	-2605	-45	23	0	0
7	-3	10494	29452	34853	-8426	23	-4	0	0
7	-2	75304	166514	160486	-75240	-756	1530	0	1
7	-1	-17587	-73374	73432	-17640	53	-103	0	0
7	0	-77038	-168464	168368	-76993	3	-32	0	0
7	1	-3692	-8057	8054	-3690	0	0	0	0
7	2	-200	-436	436	-200	0	0	0	0
7	3	-11	-25	25	-11	0	0	0	0
7	4	0	-1	1	0	0	0	0	0
8	-9	1	0	-2	3	0	0	0	0
8	-8	29	6	-7	10	0	0	0	0
8	-7	74	38	-18	122	1	0	0	0
8	-6	-427	33	-87	-485	-6	-2	0	0
8	-5	652	-305	382	697	11	0	0	0
8	-4	-512	439	-623	-529	-11	4	0	0
8	-3	195	-826	140	283	9	-8	0	0
8	-2	-17	510	-259	-109	11	-18	0	0
8	-1	121	940	-940	121	-1	2	0	0
8	0	-35	-74	74	-35	0	0	0	0
8	1	-2	-4	4	-2	0	0	0	0
9	-9	-5	-4	3	-2	0	0	0	0
9	-8	-9	-13	13	-18	0	0	0	0
9	-7	91	33	-28	106	1	0	0	0
9	-6	-183	5	-15	-197	-3	0	0	0
9	-5	184	-69	82	193	3	0	0	0
9	-4	-112	83	-111	-119	-2	0	0	0
9	-3	48	-104	50	49	2	-1	0	0
9	-2	-16	65	-60	-17	0	0	0	0
9	-1	1	65	-65	1	0	0	0	0
9	12	2	1	1	-2	0	0	0	0
10	-12	0	2	-2	0	0	0	0	0
10	-10	0	1	0	0	0	0	0	0
10	-9	0	3	-4	2	0	0	0	0
10	-8	-16	-15	16	-19	0	0	0	0
10	-7	43	18	-17	47	0	0	0	0
10	-6	-55	-3	1	-58	0	0	0	0
10	-5	43	-12	14	44	0	0	0	0
10	-4	-22	13	-18	-23	0	0	0	0
10	-3	9	-15	9	9	0	0	0	0
10	-2	-4	10	-10	-4	0	0	0	0
10	-1	0	6	-6	0	0	0	0	0
10	12	0	-1	-1	0	0	0	0	0
11	-12	1	0	0	1	0	0	0	0
11	-11	0	-2	2	0	0	0	0	0
11	-9	2	5	-5	2	0	0	0	0
11	-8	-8	-9	9	-9	0	0	0	0
11	-7	14	7	-7	15	0	0	0	0
11	-6	-14	-2	2	-14	0	0	0	0
11	-5	9	-2	2	9	0	0	0	0
11	-4	-4	2	-3	-4	0	0	0	0
11	-3	2	-2	1	1	0	0	0	0
11	-2	0	2	-2	0	0	0	0	0
11	12	1	4	4	-1	0	0	0	0
12	-12	0	4	-4	0	0	0	0	0
12	-10	0	-1	1	0	0	0	0	0
12	-9	0	3	-3	1	0	0	0	0
12	-8	-3	-3	3	-3	0	0	0	0
12	-7	4	2	-2	4	0	0	0	0
12	-6	-3	0	0	-3	0	0	0	0
12	-5	2	0	0	2	0	0	0	0
12	11	0	-2	-2	0	0	0	0	0
12	12	1	0	0	-1	0	0	0	0

Table A-5. (Cont.)
f) Uranus on Jupiter

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC				(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-331	0	0	0	-70	0
0	1	0	0	94	-8	0	0	20	-2
0	2	0	-2	3	0	0	-2	1	0
1	-4	0	0	0	0	1	-2	0	0
1	-3	0	-1	-2	0	9	-28	-4	-1
1	-2	-8	-55	-61	-4	163	-463	-56	-19
1	-1	3529	-8294	-3661	-1557	3540	-8427	-784	-329
1	0	252	-2691	114	-15	421	-3096	66	15
1	1	-5	-95	54	-3	17	-249	28	2
1	2	0	-1	1	0	1	-15	2	0
1	3	0	0	0	0	0	-1	0	0
2	-5	0	0	0	0	1	-1	0	0
2	-4	3	-2	-4	-4	18	-16	-2	-3
2	-3	90	-76	-85	-98	263	-238	-35	-39
2	-2	3372	-3126	-2141	-2309	3546	-3310	-469	-504
2	-1	3518	-3739	-1550	-1477	3680	-3895	-311	-294
2	0	-18	-95	-12	-27	162	-285	18	13
2	1	-1	-3	2	0	9	-19	2	1
2	2	0	0	0	0	1	-1	0	0
3	-5	-1	0	0	1	-2	0	0	0
3	-4	-16	4	5	18	-28	6	1	5
3	-3	-324	103	77	253	-268	60	12	47
3	-2	1144	-861	-559	-735	1160	-885	-121	-160
3	-1	670	-608	-222	-250	724	-649	-42	-47
3	0	-5	-3	-2	-4	30	-34	3	3
3	1	0	0	0	0	2	-2	0	0
4	-5	3	1	1	-4	5	1	0	-1
4	-4	44	5	5	-37	39	6	1	-7
4	-3	-128	28	22	96	-111	20	4	19
4	-2	289	-174	-107	-175	289	-177	-23	-38
4	-1	118	-93	-28	-37	131	-101	-5	-6
4	0	-1	0	0	-1	6	-5	0	1
5	-6	-1	0	0	1	-1	-1	0	0
5	-5	-6	-4	-3	5	-5	-3	-1	1
5	-4	21	4	3	-17	19	4	1	-4
5	-3	-31	4	3	23	-27	2	0	5
5	-2	70	-33	-19	-40	70	-34	-4	-9
5	-1	24	-16	-4	-6	27	-18	-1	-1
5	0	0	0	0	0	1	-1	0	0
6	-6	1	1	1	-1	1	1	0	0
6	-5	-3	-2	-2	3	-3	-2	0	1
6	-4	6	2	1	-5	5	2	0	-1
6	-3	-6	0	0	4	-5	0	0	1
6	-2	20	-7	-4	-11	21	-7	-1	-2
6	-1	8	-5	-1	-1	9	-5	0	0
7	-6	0	1	1	0	0	1	0	0
7	-5	-1	-1	-1	1	-1	-1	0	0
7	-4	1	0	0	-1	1	0	0	0
7	-3	-1	0	0	0	2	-1	0	0
7	-2	39	-9	-5	-20	45	-12	-1	-5
7	-1	130	-60	-1	-1	132	-60	0	0
7	0	0	0	0	0	6	-3	0	1
8	-2	-1	0	0	0	-1	0	0	0

Table A-5. (Cont.)
 Secular Terms
 f) Uranus on Jupiter

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-545901	0	-5373884	0	21793	0
1	-13167	43252	43252	-21961	-300823	641465
2	181120	1789211	-1787124	180908	-7253	15469
3	13113	129391	-129316	13106	-262	560
4	843	8319	-8316	843	-11	24
5	53	522	-522	53	0	1
6	3	33	-33	3	0	0
7	0	2	-2	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	946	0	-26	0	60	0
1	-19605	1993	-996	-9802	-822	1754
2	-237	24	-24	-236	-20	42
3	-5	1	-1	-8	-1	2
4	0	-1	0	-1	0	0
5	0	1	0	0	0	0
8	0	1	0	0	0	0
12	0	-1	0	0	0	0

Table A-5. (Cont.)
Periodic Terms
g) Neptune on Jupiter

		DY				DZ				U/COS(I)	
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	43467	0	-428	0	697	0	0	0		
0	1	-242949	200	117	-242173	0	0	0	0		
0	2	20111	-429	429	20118	-96	-293	0	0		
0	3	756	-38	38	756	-3	-10	0	0		
0	4	26	-3	3	26	0	0	0	0		
1	-7	-2	1	1	2	0	0	0	0		
1	-6	-29	19	18	29	0	0	0	0		
1	-5	-469	296	296	469	0	0	0	0		
1	-4	-7505	4723	4721	7502	0	-2	0	0		
1	-3	-117601	73657	73615	117533	-17	-71	0	0		
1	-2	-1656812	1028525	1027418	1654939	-666	-2739	0	-1		
1	-1	-74059	207485	182239	17915	4353	2585	2	1		
1	0	4606722	-2829829	2840580	4596127	-6913	-6378	-3	-3		
1	1	194386	-274573	274359	194424	-4838	-2129	-2	-1		
1	2	7020	-14665	14659	7020	-117	-55	0	0		
1	3	336	-827	827	336	-4	-2	0	0		
1	4	18	-48	48	18	0	0	0	0		
1	5	1	-3	3	1	0	0	0	0		
2	-7	6	-12	-12	-6	0	0	0	0		
2	-6	91	-177	-177	-91	0	0	0	0		
2	-5	1343	-2612	-2611	-1342	0	0	0	0		
2	-4	18551	-36182	-36162	-18541	-12	-7	0	0		
2	-3	211141	-413781	-413419	-210981	-292	-177	0	0		
2	-2	570339	-1146984	-1148038	-572081	-3624	-702	-1	0		
2	-1	-974749	1893561	-1939544	-993202	-135003	-26542	-54	-11		
2	0	-1531580	3072606	-3072381	-1531393	12504	2330	5	1		
2	1	-58563	121428	-121400	-58551	691	97	0	0		
2	2	-2620	5477	-5476	-2619	18	3	0	0		
2	3	-138	290	-290	-138	0	0	0	0		
2	4	-8	16	-16	-8	0	0	0	0		
3	-7	0	-9	-10	0	0	0	0	0		
3	-6	-5	-127	-127	5	0	0	0	0		
3	-5	-54	-1489	-1491	54	-1	0	0	0		
3	-4	-217	-12640	-12734	218	-19	-6	0	0		
3	-3	8532	4852	526	-8353	90	-35	0	0		
3	-2	25592	120808	-138330	-6355	3371	-1292	1	-1		
3	-1	-39938	-15040	14731	-40475	-635	-1371	0	-1		
3	0	-40364	21118	-21116	-40358	64	143	0	0		
3	1	-1573	832	-832	-1573	6	6	0	0		
3	2	-72	38	-38	-72	0	0	0	0		
3	3	-4	2	-2	-4	0	0	0	0		
4	-7	-5	-8	-9	6	0	0	0	0		
4	-6	-59	-88	-89	60	0	0	0	0		
4	-5	-402	-622	-647	418	-2	0	0	0		
4	-4	583	296	-407	-108	7	-8	0	0		
4	-3	6852	9817	-9582	6943	156	-194	0	0		
4	-2	-3047	860	-921	-3352	59	73	0	0		
4	-1	218	-603	602	214	5	-9	0	0		
4	0	-343	53	-53	-342	0	0	0	0		
4	1	-13	2	-2	-13	0	0	0	0		
4	8	0	-1	-1	0	0	0	0	0		
5	-8	0	0	0	1	0	0	0	0		
5	-7	-7	-3	-5	10	0	0	0	0		
5	-6	-49	-24	-27	55	0	0	0	0		
5	-5	86	13	-48	48	0	-2	0	0		
5	-4	1202	528	-515	1199	3	-25	0	0		
5	-3	-254	286	-288	-250	7	3	0	0		
5	-2	-19	-53	51	-21	0	1	0	0		
5	-1	8	3	-3	8	0	0	0	0		
5	0	-3	2	-2	-3	0	0	0	0		
5	8	-5	-2	-2	5	0	0	0	0		
6	-8	2	0	0	3	0	0	0	0		
6	-7	0	0	0	10	0	0	0	0		
6	-6	13	-4	0	12	0	0	0	0		
6	-5	158	-21	21	158	-1	-3	0	0		
6	-4	-8	50	-50	-8	0	0	0	0		
6	-3	-6	-4	4	-6	0	0	0	0		
6	7	-1	0	0	1	0	0	0	0		
6	8	-13	1	1	13	0	0	0	0		
7	-8	5	-4	5	6	0	0	0	0		
7	-7	8	-6	6	8	0	0	0	0		
7	-6	17	-13	13	17	0	0	0	0		
7	-5	3	7	-7	3	0	0	0	0		
7	-4	-1	0	0	-1	0	0	0	0		
7	7	-2	2	2	-2	0	0	0	0		
7	8	-18	15	15	18	0	0	0	0		
8	-8	4	-12	13	4	0	0	0	0		
8	-7	4	-14	14	4	0	0	0	0		
8	-6	1	0	0	1	0	0	0	0		
8	7	-1	5	5	2	0	0	0	0		
8	8	-10	31	32	10	0	0	0	0		

Table A-5. (Cont.)
g) Neptune on Jupiter

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)				(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-96	0	0	0	-20	0
0	1	0	0	21	0	0	0	4	0
0	2	0	0	1	0	0	0	0	0
1	-4	0	0	0	0	0	1	0	0
1	-3	1	1	1	-1	6	10	1	-1
1	-2	22	32	30	-20	96	152	19	-12
1	-1	1530	2483	1169	-720	1536	2484	246	-152
1	0	114	-21	27	-12	188	99	-7	5
1	1	3	-3	2	1	13	3	0	1
1	2	0	0	0	0	1	0	0	0
2	-4	-1	0	-1	1	-5	-2	0	1
2	-3	-22	-12	-13	26	-71	-37	-6	11
2	-2	-921	-472	-335	654	-1000	-512	-75	146
2	-1	-1622	-808	-378	758	-1666	-830	-77	155
2	0	20	11	-8	17	-61	-29	3	-5
2	1	0	0	0	0	-4	-2	0	0
3	-4	-2	0	0	3	-5	0	0	1
3	-3	-56	4	3	46	-56	3	1	10
3	-2	11	-19	-13	-5	7	-20	-3	-1
3	-1	-12	-21	-10	5	-12	-22	-2	1
3	0	0	0	0	0	0	-1	0	0
4	-4	-4	3	3	4	-4	3	1	1
4	-3	0	-2	-1	0	0	-1	0	0

Table A-5. (Cont.)
 Secular Terms
 g) Neptune on Jupiter

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-23428	0	-1122961	0	-18457	0
1	-565	9038	9038	-942	254783	-74010
2	7773	373885	-373449	7764	6143	-1785
3	563	27038	-27023	562	222	-65
4	36	1738	-1738	36	10	-3
5	2	109	-109	2	0	0
6	0	7	-7	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	198	0	-2	0	-50	0
1	-4097	85	-43	-2048	697	-202
2	-50	1	-1	-49	17	-5
3	-1	0	0	-2	1	0

Table A-6. Saturn
Periodic Terms
a) Mercury on Saturn

		DX		DY		DZ		U/COS(I)	
		(IN UNITS OF 10**(-12))						(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-50105	0	1305	0	-1703	0	0	0
0	1	536673	-118	174	536479	0	0	0	0
0	2	10117	1297	-1296	10114	-13	-6	0	0
0	3	261	80	-80	261	0	0	0	0
0	4	7	4	-4	7	0	0	0	0
1	-3	5	1	1	-5	0	0	0	0
1	-2	59	16	17	-63	0	0	0	0
1	-1	-72	-19	20	-77	0	0	0	0
1	0	52700	13579	-14210	52103	5488	4645	1	1
1	1	-73	-20	19	-74	0	0	0	0
1	2	-2	0	0	-2	0	0	0	0
2	-2	6	1	2	-7	0	0	0	0
2	-1	-14	-4	4	-15	0	0	0	0
2	0	4377	1123	-1188	4337	557	473	0	0
2	1	-14	-4	4	-14	0	0	0	0
3	-2	0	0	0	-1	0	0	0	0
3	-1	-3	0	0	-3	0	0	0	0
3	0	518	132	-142	514	85	72	0	0
3	1	-3	0	0	-3	0	0	0	0
4	0	67	17	-19	66	15	13	0	0
5	0	8	2	-2	8	3	3	0	0

		NDZ		NU		D (LONG.)		D LOG(R)	
		----- (IN UNITS OF 10**(-4) SECONDS OF ARC) -----						(IN UNITS OF 10**(-9))	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	116	0	0	0	24	0
0	1	0	0	-2	1	0	0	0	0
1	-2	0	0	1	0	0	1	0	0
1	-1	-3	11	11	3	-3	11	2	1
1	0	0	-1	0	0	0	0	0	0
2	-1	0	1	1	0	0	1	0	0

Table A-6. (Cont.)
 Secular Terms
 a) Mercury on Saturn

J	DX		DY		DZ	
	COS	SIN	COS	SIN	COS	SIN
0	33	0	-919	0	41	0
1	0	9	9	2	-487	1323
2	-11	306	-305	-11	-14	37
3	0	26	-26	0	0	2
4	0	2	-2	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**(-6)}$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	0	0	-3	0	0	0
1	-4	0	1	-2	-2	5
3	0	-2	0	1	0	0
4	0	-1	-1	0	0	0
5	0	1	0	0	0	0
6	1	0	-1	0	0	0
7	-2	-1	0	0	0	0
8	0	2	0	0	0	0
9	1	0	0	0	0	0
10	0	0	1	0	0	0
11	0	1	0	1	0	0
12	0	-1	0	0	0	0

Table A-6. (Cont.)

Periodic Terms

b) Venus on Saturn

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	-655260	0	-2894	0	-287	0	0	0		
0	1	7752221	233	-415	7745609	0	0	0	0		
0	2	214480	-2871	2865	214358	-240	-127	0	0		
0	3	8774	-250	250	8770	-16	-9	0	0		
0	4	423	-19	19	423	-1	0	0	0		
0	5	22	-1	1	22	0	0	0	0		
0	6	1	0	0	1	0	0	0	0		
1	-4	10	-8	-8	-11	0	0	0	0		
1	-3	133	-107	-109	-135	0	0	0	0		
1	-2	1385	-1137	-1180	-1437	0	0	0	0		
1	-1	-689	566	-655	-797	0	0	0	0		
1	0	1283619	-1054753	1054415	1284757	62387	-12259	13	-3		
1	1	-725	595	-595	-725	0	0	0	0		
1	2	-25	20	-20	-25	0	0	0	0		
1	3	-1	0	0	-1	0	0	0	0		
2	-5	0	-2	-2	0	0	0	0	0		
2	-4	2	-9	-9	-2	0	0	0	0		
2	-3	7	-32	-32	-7	0	0	0	0		
2	-2	4	-3	-1	-4	0	0	0	0		
2	-1	-3	-1	1	-4	0	0	0	0		
2	0	4110	-3378	3377	4114	213	-42	0	0		
2	1	-4	4	-4	-4	0	0	0	0		
3	-4	0	-1	-1	0	0	0	0	0		
3	0	20	-16	16	20	1	0	0	0		
		NDZ		NU		D (LONG.)		D LOG(R)			
		(IN UNITS OF 10**(-4) SECONDS OF ARC)									
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	0	0	1678	0	0	0	353	0		
0	1	0	0	-1	-1	0	0	0	0		
1	-3	0	0	1	-1	1	2	0	0		
1	-2	6	8	15	-13	19	23	5	-4		
1	-1	228	277	278	-228	227	277	58	-48		
1	0	-19	-24	0	0	-7	-8	-2	1		
2	-1	1	1	1	-1	1	1	0	0		

Table A-6. (Cont.)

Secular Terms

b) Venus on Saturn

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-368	0	-49736	0	854	0
1	-10	465	465	-17	-10139	18832
2	122	16553	-16527	122	-284	528
3	10	1390	-1389	10	-12	22
4	0	104	-104	0	0	1
5	0	8	-8	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	14	0	-3	0	3	0
1	-246	1	-1	-122	-38	70
2	-3	0	0	-3	-1	2
3	1	0	1	0	0	0
4	0	-1	-1	0	0	0
5	0	1	0	0	0	0
6	1	1	0	1	0	0
7	0	-1	0	1	0	0
8	0	1	0	0	0	0
9	-1	0	-1	1	0	0
10	1	0	-1	0	0	0
11	-1	1	0	0	0	0

Table A-6. (Cont.)
 Periodic Terms
 c) Earth on Saturn

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-827743	0	-3452	0	-258	0	0	0	
0	1	9658587	300	-473	9650616	0	0	0	0	
0	2	255892	-3428	3426	255752	-283	710	0	0	
0	3	9944	-231	231	9939	-19	48	0	0	
0	4	455	-13	13	455	-1	3	0	0	
0	5	23	0	0	23	0	0	0	0	
0	6	1	0	0	1	0	0	0	0	
1	-4	16	0	0	-16	0	0	0	0	
1	-3	286	-44	-45	-291	0	0	0	0	
1	-2	3221	-583	-600	-3312	-2	-3	0	0	
1	-1	-1044	189	-232	-1274	0	0	0	0	
1	0	2874898	-518719	520437	2872224	27509	-129549	6	-28	
1	1	-1106	199	-199	-1106	0	0	0	0	
1	2	-40	8	-8	-40	0	0	0	0	
1	3	-2	0	0	-2	0	0	0	0	
2	-6	1	0	0	-1	0	0	0	0	
2	-5	10	-3	-3	-10	0	0	0	0	
2	-4	54	-20	-20	-54	0	0	0	0	
2	-3	191	-71	-71	-190	0	0	0	0	
2	-2	20	-3	1	-10	0	1	0	0	
2	-1	17	-9	9	14	0	6	0	0	
2	0	23179	-4182	4197	23156	231	-1086	0	0	
2	1	-15	3	-3	-15	0	0	0	0	
3	-5	4	-2	-2	-4	0	0	0	0	
3	-4	10	-6	-6	-10	0	0	0	0	
3	-2	1	0	0	0	0	0	0	0	
3	0	280	-50	51	280	3	-14	0	0	
4	0	4	0	0	4	0	0	0	0	

		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	2091	0	0	0	440	0	
0	1	0	0	-6	-1	0	0	-1	0	
1	-3	0	1	2	0	1	4	1	0	
1	-2	3	17	35	-6	9	52	11	-2	
1	-1	112	621	622	-112	112	619	131	-24	
1	0	-10	-53	0	0	-3	-18	-4	1	
1	1	0	0	0	0	0	-1	0	0	
2	-1	1	5	5	-1	1	5	1	0	

Table A-6. (Cont.)

Secular Terms

c) Earth on Saturn

J	DX		DY		DZ	
	COS	SIN	COS	SIN	COS	SIN
0	-839	0	-115450	0	-4847	0
1	-24	1080	1080	-39	57574	23528
2	278	38423	-38362	278	1612	659
3	23	3227	-3225	23	68	28
4	2	241	-241	2	3	1
5	0	18	-18	0	0	0
6	0	1	-1	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**(-6)}$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N \cdot T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	32	0	-3	0	-18	0
1	-570	4	-1	-285	213	87
2	-8	0	0	-8	6	2
3	1	-1	1	0	0	0
4	-1	-1	-1	0	0	0
5	-1	1	-1	0	0	0
6	1	0	0	0	0	0
8	1	2	0	0	0	0
9	-1	-1	-1	0	0	0
11	1	2	0	0	0	0
12	0	-2	0	-1	0	0

Table A-6. (Cont.)

Periodic Terms

d) Mars on Saturn

J	K	DX ----- (IN UNITS OF 10**(-12)) -----		DY ----- (IN UNITS OF 10**(-12)) -----		DZ ----- (IN UNITS OF 10**(-12)) -----		U/COS(I) (10**(-4) SECONDS OF ARC)	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-77024	0	15863	0	475	0	0	0
0	1	1027551	-1119	2434	1026004	0	0	0	0
0	2	38237	15724	-15675	38216	-238	24	0	0
0	3	1722	1567	-1565	1722	-18	-1	0	0
0	4	72	138	-138	72	-1	0	0	0
0	5	2	12	-12	2	0	0	0	0
1	-6	3	2	2	-3	0	0	0	0
1	-5	16	14	14	-16	0	0	0	0
1	-4	59	75	75	-58	0	0	0	0
1	-3	115	278	278	-113	0	-2	0	0
1	-2	-295	566	565	311	3	-4	0	0
1	-1	45	-69	106	118	-3	-3	0	0
1	0	-214227	423217	-424582	-213597	-1297	19983	0	4
1	1	34	-107	107	34	2	-1	0	0
1	2	-1	-5	5	-1	0	0	0	0
2	-6	-3	0	0	3	0	0	0	0
2	-5	-13	-7	-7	13	0	0	0	0
2	-4	-48	-42	-42	48	0	0	0	0
2	-3	-109	-146	-145	108	0	0	0	0
2	-2	-10	24	33	0	1	0	0	0
2	-1	-15	-32	34	-14	5	3	0	0
2	0	-9766	19302	-19352	-9744	-60	931	0	0
2	1	4	-8	8	4	0	0	0	0
3	-6	1	-1	-1	-1	0	0	0	0
3	-5	6	-3	-3	-6	0	0	0	0
3	-4	13	-4	-4	-13	0	0	0	0
3	-3	-5	-6	-5	6	0	0	0	0
3	-2	1	1	2	2	0	0	0	0
3	-1	0	-2	2	0	0	0	0	0
3	0	-667	1320	-1323	-666	-4	65	0	0
4	-5	0	1	1	0	0	0	0	0
4	-4	1	0	0	-1	0	0	0	0
4	0	-54	107	-107	-54	0	5	0	0
5	0	-5	10	-10	-5	0	0	0	0

J	K	NDZ ----- (IN UNITS OF 10**(-4) SECONDS OF ARC) -----		NU ----- (IN UNITS OF 10**(-4) SECONDS OF ARC) -----		D (LONG.) ----- (IN UNITS OF 10**(-9)) -----		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	222	0	0	0	47	0
0	1	0	0	4	7	0	0	1	1
0	2	0	0	0	1	0	0	0	0
1	-3	0	0	0	0	-1	0	0	0
1	-2	-2	-1	-3	5	-8	-4	-1	2
1	-1	-92	-46	-46	92	-91	-46	-10	19
1	0	8	4	0	0	3	1	0	-1
2	-1	-4	-2	-2	4	-4	-2	0	1

Table A-6. (Cont.)

Secular Terms

d) Mars on Saturn

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	9011	0	-35221	0	-479	0
1	252	329	329	421	5695	13578
2	-2985	11722	-11703	-2980	159	380
3	-251	985	-984	-251	7	16
4	-19	74	-73	-19	0	0
5	-1	5	-5	-1	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	9	0	-3	0	-2	0
1	-173	-46	22	-85	21	50
2	-4	0	0	-2	1	1
3	0	-1	1	-1	0	0
4	0	0	-1	0	0	0
5	0	2	0	0	0	0
6	1	-1	0	0	0	0
7	-1	0	-1	1	0	0
8	0	1	0	0	0	0
9	1	-1	0	0	0	0
10	0	1	0	1	0	0
11	-1	0	0	0	0	0

Table A-6. (Cont.)

Periodic Terms

e) Jupiter on Saturn

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-355923703	0	141118264	0	-14995714	0	-3243	0	
0	1	3950609411	-3958273	39546234	3937604792	0	0	0	0	
0	2	219027395	180529427	-179549311	219444264	-9419362	3100257	-2037	670	
0	3	5759753	11974843	-11943661	5810993	-811103	-47195	-175	-10	
0	4	-200423	632450	-632302	-196198	-56213	-29184	-12	-6	
0	5	-51803	18395	-18532	-51509	-2962	-4059	-1	-1	
0	6	-5741	-1475	1454	-5726	-55	-408	0	0	
0	7	-486	-363	361	-486	13	-33	0	0	
0	8	-34	-47	47	-34	2	-2	0	0	
0	9	-2	-5	5	-2	0	0	0	0	
1	-11	-10	3	3	10	0	0	0	0	
1	-10	-131	32	32	131	0	0	0	0	
1	-9	-1770	384	383	1769	-4	8	0	0	
1	-8	-23947	4995	4993	23935	-90	60	0	0	
1	-7	-328952	72370	72372	328787	-1325	162	0	0	
1	-6	-4648488	1135421	1135623	4646187	-16235	-4975	-4	-1	
1	-5	-68376511	18533316	18533849	68340628	-176823	-135868	-38	-29	
1	-4	-1054932852	299587795	299431081	1054225180	-1754907	-2353995	-379	-509	
1	-3	-12506184199	-42046958	-61011172	12485779332	-931698	33013844	-201	7139	
1	-2	1930425968	3459040424	4724666030	273016577	-98468438	94915826	-21292	20524	
1	-1	7031786817	113503225	-109077491	7156098941	-20264738	29853100	-4382	6455	
1	0	1366593676	4085357575	-4089019840	1371331124	75233515	35560389	16268	7689	
1	1	12541718	-77855813	77692636	12764437	-1325591	-2008599	-287	-434	
1	2	353177	-6842200	6826523	364387	-23255	-209839	-5	-45	
1	3	6376	-581269	579888	6763	6003	-17132	1	-4	
1	4	874	-48919	48810	858	1105	-1099	0	0	
1	5	268	-4079	4073	262	128	-42	0	0	
1	6	49	-335	336	48	12	2	0	0	
1	7	6	-28	28	6	0	0	0	0	
1	8	0	-3	3	0	0	0	0	0	
2	-15	0	-2	-2	0	0	0	0	0	
2	-14	-9	-23	-23	9	0	0	0	0	
2	-13	-130	-322	-321	130	0	0	0	0	
2	-12	-1827	-4507	-4506	1827	0	0	0	0	
2	-11	-25841	-63770	-63755	25835	-2	-1	0	0	
2	-10	-370470	-914107	-913867	370372	-14	-41	0	0	
2	-9	-5415374	-13349137	-13344921	5413677	-42	-836	0	0	
2	-8	-81554497	-200634526	-200555451	81522799	2276	-16251	0	-4	
2	-7	-1293946666	-3170885056	-3169222172	1293281256	91247	-351074	20	-76	
2	-6	-23073889298	-55948875405	-55904946195	23056408861	3517185	-10975681	761	-2373	
2	-5	2613700806	-22506336313	-22340469699	-2783409697	28654176	7576594	6196	1638	
2	-4	23303980520	58997459496	-56217120992	25151029069	-412996229	-49463974	-89305	-10696	
2	-3	-914577069	11420930646	-10315711623	1696913218	6643452	10634874	1437	2300	
2	-2	153925355	662336310	-704122752	96756654	-3223746	-3929152	-697	-850	
2	-1	45744722	28805580	-29572647	46223778	2520251	-11684777	545	-2527	
2	0	33623313	113454444	-113551818	33631572	2847279	434897	616	94	
2	1	893624	-452079	447542	891346	55728	-33597	12	-7	
2	2	81944	-49635	49380	81637	5372	-565	1	0	
2	3	7603	-4726	4723	7573	428	161	0	0	
2	4	714	-405	408	713	26	30	0	0	
2	5	68	-34	35	69	0	3	0	0	
2	6	7	-4	4	8	0	0	0	0	
2	7	1	0	0	1	0	0	0	0	

Table A-6. (Cont.)
e) Jupiter on Saturn

3	-15	0	-1	-1	0	0	0	0
3	-14	3	-15	-15	-3	0	0	0
3	-13	53	-212	-212	-53	0	0	0
3	-12	773	-2963	-2962	-772	-3	-6	0
3	-11	11060	-42452	-42434	-11056	-10	-81	0
3	-10	161291	-631676	-631361	-161205	224	-1006	0
3	-9	2557450	-9881752	-9874817	-2556190	5956	-11248	1
3	-8	60517440	-130685996	-130440752	-60543118	-145323	108638	-31
3	-7	-141209481	101919071	84028300	141801260	-1585383	-1114899	-343
3	-6	-175550760	82804871	-72598402	99991354	2736402	4181989	592
3	-5	-174678095	-118395887	-88107125	230802393	490214	3809679	106
3	-4	-161304507	-252861735	-248310667	192335716	-1124072	3028759	-243
3	-3	5198239	18307668	13129604	8857188	1438076	-1200367	311
3	-2	-3002281	-6706673	5818062	-3826187	3987389	21644	862
3	-1	119302	783135	-789259	108607	219256	-36012	47
3	0	983792	4208154	-4209009	983070	101962	47105	22
3	1	13557	673	-623	13467	824	1200	0
3	2	1483	171	-163	1486	10	126	0
3	3	157	31	-31	160	-5	10	0
3	4	20	5	-6	21	0	0	0
3	5	4	2	-2	4	0	0	0
4	-16	69	-63	-63	-69	0	0	0
4	-15	982	-901	-901	-982	0	0	0
4	-14	14310	-13155	-13151	-14306	2	-2	0
4	-13	214340	-197776	-197699	-214255	46	-19	0
4	-12	3368148	-3129001	-3127404	-3366379	990	-214	0
4	-11	5858251	-55309050	-55267609	-58502156	28948	-3470	6
4	-10	62862132	-17166057	-16526116	-62596133	-2334	126180	-1
4	-9	-71548485	57126676	-62471376	-51333698	-310396	-1855325	-67
4	-8	-36007469	-2122576	-20389699	-15196160	-116866	324224	-25
4	-7	-8249716	-31193913	-33350521	6978711	-385402	408740	-83
4	-6	18550822	-64855626	-66482994	-17171650	-816735	282585	-177
4	-5	61799716	-66803620	-68312119	-61346794	-758366	-98498	-164
4	-4	-8055230	-1154294	245572	8464622	616968	559636	133
4	-3	2944378	-2572830	3247357	2593116	308784	1461743	67
4	-2	-278782	-198754	183146	-294625	74844	50391	16
4	-1	-9601	29771	-29398	-9666	334	2940	0
4	0	38537	181386	-181394	38584	3521	1976	1
4	1	162	272	-281	167	-31	14	0
4	2	25	45	-50	25	-3	0	0
4	3	4	12	-14	3	0	0	0
4	4	0	4	-5	0	0	0	0
4	5	0	1	-1	0	0	0	0
4	16	5	-5	-5	-5	0	0	0
5	-16	236	-25	-25	-237	0	0	0
5	-15	3515	-396	-391	-3517	5	0	0
5	-14	55170	-5983	-5974	-55133	56	3	0
5	-13	813941	44830	45469	-812709	-918	-480	0
5	-12	-879766	-568306	-604700	795345	3924	-11892	1
5	-11	-853154	-843021	-766077	-159691	-25933	32616	-6
5	-10	377330	-1728477	-1984346	-65027	-38676	18256	-8
5	-9	2906235	-3782733	-3971228	-2798197	-82323	-4431	-18
5	-8	11030380	-5000509	-5195559	-11036790	-144214	-87200	-31
5	-7	25270117	1476902	1342657	-25358288	-145072	-237855	-31
5	-6	27590602	15575069	15661983	-27430418	-26874	-205571	-6
5	-5	356680	-4228602	-4274874	1079711	-210669	329207	-46
5	-4	1177501	953856	-661801	1642110	-543951	248059	-118
5	-3	99275	-167649	183366	85716	2967	50400	1
5	-2	-14194	-4112	3604	-14423	702	172	0
5	-1	-985	1179	-1202	-993	-80	-74	0
5	0	1685	8532	-8541	1674	168	70	0
5	1	-21	30	-31	-26	0	-1	0
5	2	-11	8	-8	-13	0	0	0
5	3	-5	1	0	-5	0	0	0
5	4	-2	0	0	-2	0	0	0
5	15	1	0	0	-1	0	0	0
5	16	21	7	7	-21	0	0	0

Table A-6. (Cont.)

e) Jupiter on Saturn

6	-16	164416	78819	78773	-164267	48	95	0	0
6	-15	143919	190641	190607	-141410	-479	118	0	0
6	-14	-188261	-140603	23267	-175721	6948	-3759	2	-1
6	-13	-20127	-159370	-10297	-103183	-2690	52	-1	0
6	-12	198490	-132465	-137914	-206235	-4686	-2132	-1	0
6	-11	702498	-43998	-57659	-708940	-7371	-9731	-2	-2
6	-10	1839624	865451	854439	-1853968	-4575	-29457	-1	-6
6	-9	3115803	4208898	4207233	-3131788	21140	-61147	5	-13
6	-8	1664248	10370762	10361954	-1638140	73759	-71399	16	-15
6	-7	-3303902	11508199	11333981	3448447	49937	-24711	11	-5
6	-6	2185299	-184853	-929558	-2046405	-174824	-70831	-38	-15
6	-5	-298446	469739	-754219	-58796	-151674	-197909	-33	-43
6	-4	94764	33020	-17743	106317	-26130	14607	-6	3
6	-3	1046	-8680	9022	450	665	1195	0	0
6	-2	-841	-217	213	-891	64	-47	0	0
6	-1	-125	27	-13	-139	3	-5	0	0
6	0	48	409	-403	46	9	4	0	0
6	1	-13	-10	13	-13	0	0	0	0
6	2	-3	-6	6	-2	0	0	0	0
6	3	0	-2	2	0	0	0	0	0
6	13	3	1	1	-3	0	0	0	0
6	14	39	20	20	-39	0	0	0	0
6	15	587	303	302	-587	0	0	0	0
6	16	9206	4689	4686	-9202	3	3	0	0
7	-16	3511	-3713	-3458	-3566	60	31	0	0
7	-15	11355	-4573	-1056	-10546	-201	-207	0	0
7	-14	31622	9238	8717	-32299	-188	-648	0	0
7	-13	73602	75419	75007	-74855	397	-1792	0	0
7	-12	87719	321687	322056	-89455	3327	-3824	1	-1
7	-11	-226042	950065	951157	224989	12111	-4596	3	-1
7	-10	-1618951	1837227	1833101	1620681	27429	3272	6	1
7	-9	-4295073	1706533	1671582	4289377	33831	21745	7	5
7	-8	-4761953	-189236	-298001	4675118	11232	6783	2	1
7	-7	317304	1079596	937808	-651377	17437	-90891	4	-20
7	-6	-174766	-102885	-80393	-329920	67561	-82863	15	-18
7	-5	-6680	48765	-55500	7521	-13131	-11329	-3	-2
7	-4	5150	-512	1295	5361	-778	979	0	0
7	-3	-110	-586	656	-123	57	50	0	0
7	-2	-67	-107	128	-53	4	0	0	0
7	-1	-1	-49	54	7	0	0	0	0
7	0	14	3	-3	17	0	0	0	0
7	1	6	-5	4	7	0	0	0	0
7	2	3	0	0	3	0	0	0	0
7	14	-1	12	12	1	0	0	0	0
7	15	-22	188	188	22	0	0	0	0
7	16	-754	3573	3569	755	7	-5	0	0
8	-16	2377	4344	4257	-1708	-90	105	0	0
8	-15	999	17483	14442	3691	243	-126	0	0
8	-14	-30345	44955	44855	30663	847	11	0	0
8	-13	-155003	78562	78667	155048	2114	1180	0	0
8	-12	-498902	-13077	-13781	498577	3323	5147	1	1
8	-11	-1044871	-583542	-586419	1040185	1235	12386	0	3
8	-10	-1190950	-1740925	-1741723	1166958	-5218	15305	-1	3
8	-9	-404326	-1921717	-1887833	336514	3026	2927	1	1
8	-8	-504719	276363	414489	405994	45873	-641	10	0
8	-7	44777	-62691	136798	-85139	42206	20062	9	4
8	-6	-23493	853	-12393	-26240	3900	-8961	1	-2
8	-5	960	2723	-2713	1792	-890	-315	0	0
8	-4	392	-281	317	479	-25	62	0	0
8	-3	106	-103	92	137	2	3	0	0
8	-2	63	-15	6	71	0	0	0	0
8	-1	26	6	-10	27	0	0	0	0
8	0	8	8	-9	8	0	0	0	0
8	1	1	3	-3	1	0	0	0	0
8	13	-1	0	0	20	0	0	0	0
8	14	-20	-10	-10	1	0	0	0	0
8	15	-333	-161	-161	333	0	0	0	0
8	16	-5981	-3828	-3826	5972	4	19	0	0

Table A-6. (Cont.)
e) Jupiter on Saturn

9	-16	-9484	2189	27	8402	-195	-288	0	0
9	-15	-34264	-6709	-16671	21410	75	417	0	0
9	-14	-59954	-74006	-74872	58743	-368	1182	0	0
9	-13	-48115	-259517	-259333	47181	-2141	2145	0	0
9	-12	174246	-574893	-571993	-176893	-5474	1829	-1	0
9	-11	669256	-724321	-710304	-672591	-6508	-441	-1	0
9	-10	741506	-370339	-331865	-731857	610	3628	0	1
9	-9	-194531	-220073	-161251	247175	5083	22321	1	5
9	-8	23059	24935	61038	52125	-4016	20311	-1	4
9	-7	-1820	-10932	11065	-10170	5344	714	1	0
9	-6	-1174	815	-1587	-933	25	-651	0	0
9	-5	404	237	-339	469	-54	-3	0	0
9	-4	157	110	-153	151	-1	3	0	0
9	-3	38	79	-91	29	0	0	0	0
9	-2	0	36	-38	-5	0	0	0	0
9	-1	-6	11	-11	-7	0	0	0	0
9	0	-3	2	-2	-4	0	0	0	0
9	1	-1	0	0	-1	0	0	0	0
9	13	4	-3	-3	-4	0	0	0	0
9	14	50	-50	-50	-50	0	0	0	0
9	15	816	-835	-833	-816	-2	0	0	0
9	16	17294	-13481	-13448	-17280	-58	-9	0	0
10	-16	269	-20689	-14873	-6116	739	-250	0	0
10	-15	26378	-63450	-19183	-41980	-627	-70	0	0
10	-14	130819	-56588	-52223	-132067	-1294	-828	0	0
10	-13	305721	23552	25801	-304339	-1422	-2311	0	0
10	-12	407459	231865	235404	-399897	-572	-2526	0	-1
10	-11	237150	265204	264915	-216796	-2356	1582	-1	0
10	-10	86672	-122070	-140042	-54857	-10381	4877	-2	1
10	-9	-15670	9817	-16943	37917	-9244	577	-2	0
10	-8	5164	-1167	6498	3988	387	2901	0	1
10	-7	-425	-236	-221	-1071	413	-104	0	0
10	-6	-88	534	-640	-208	-11	-40	0	0
10	-5	-107	239	-243	-163	-3	0	0	0
10	-4	-94	73	-66	-111	0	0	0	0
10	-3	-46	9	-5	-50	0	0	0	0
10	-2	-15	-4	6	-16	0	0	0	0
10	-1	-4	-3	4	-4	0	0	0	0
10	0	0	-1	1	0	0	0	0	0
10	12	0	2	2	0	0	0	0	0
10	13	2	14	15	-2	0	0	0	0
10	14	91	191	192	-90	0	0	0	0
10	15	1678	3148	3148	-1669	2	-3	0	0
10	16	21685	61242	61159	-21581	79	-142	0	0
11	-16	39551	8519	19849	-18047	93	1401	0	0
11	-15	102685	61782	65854	14281	275	-693	0	0
11	-14	27166	156610	156292	-16088	903	-907	0	0
11	-13	-62915	216538	212659	66520	838	-532	0	0
11	-12	-82180	130756	120822	84780	-1488	-1190	0	0
11	-11	70756	28163	12367	-76040	-3525	-4552	-1	-1
11	-10	-5384	-9991	-21849	-3731	-1350	-3947	0	-1
11	-9	470	2757	-1265	3276	-1450	601	0	0
11	-8	-336	85	399	-1000	133	233	0	0
11	-7	-701	100	34	-865	26	-16	0	0
11	-6	-357	-78	149	-378	0	-2	0	0
11	-5	-125	-103	127	-121	0	0	0	0
11	-4	-25	-56	62	-21	0	0	0	0
11	-3	1	-20	21	3	0	0	0	0
11	-2	3	-5	5	4	0	0	0	0
11	-1	1	0	0	2	0	0	0	0
11	11	-1	0	0	1	0	0	0	0
11	12	-5	-5	-5	5	0	0	0	0
11	13	-37	-18	-19	38	0	0	0	0
11	14	-539	57	51	543	0	0	0	0
11	15	-9226	1879	1840	9218	5	8	0	0
11	16	-164291	5809	5546	163947	254	283	0	0
12	-16	-24158	63287	5334	35586	-1805	-293	0	0
12	-15	-106368	142630	-85157	47764	457	296	0	0
12	-14	-112034	4669	-16532	105135	304	190	0	0
12	-13	-65252	-16701	-21020	60783	470	-1087	0	0
12	-12	-4660	38349	39963	-2412	1837	-2230	0	0
12	-11	6221	-3631	-160	-12331	1548	-1074	0	0
12	-10	-1994	86	-923	-878	-506	-661	0	0
12	-9	-740	-687	1575	-457	-116	117	0	0
12	-8	-392	-911	1161	-252	17	14	0	0
12	-7	1	-514	563	87	2	0	0	0
12	-6	100	-197	198	131	0	0	0	0
12	-5	65	-48	44	73	0	0	0	0
12	-4	26	-4	2	27	0	0	0	0
12	-3	7	2	-3	7	0	0	0	0
12	-2	1	1	-2	1	0	0	0	0
12	11	5	-3	-3	-5	0	0	0	0
12	12	26	-8	-9	-26	0	0	0	0
12	13	101	-47	-51	-105	0	0	0	0
12	14	271	-1077	-1082	-300	0	-1	0	0
12	15	1371	-20247	-20183	-1503	-15	4	0	0

Table A-6. (Cont.)
e) Jupiter on Saturn

12	16	82908	-323086	-321996	-83389	-637	282	0	0
13	-16	-84489	-42552	-34925	-29107	347	-1287	0	0
13	-15	-166376	-140737	36061	-145303	26	83	0	0
13	-14	-15219	-36345	-20869	-13190	692	109	0	0
13	-13	-19993	3146	6952	19947	1286	650	0	0
13	-12	2597	3767	7710	-534	658	534	0	0
13	-11	-87	-2134	1906	556	264	-347	0	0
13	-10	849	-1652	1638	1999	-87	-49	0	0
13	-9	1144	-868	744	1513	-7	15	0	0
13	-8	710	-154	57	797	0	2	0	0
13	-7	290	75	-113	300	0	0	0	0
13	-6	80	70	-80	77	0	0	0	0
13	-5	12	31	-33	10	0	0	0	0
13	-4	0	9	-9	-2	0	0	0	0
13	-3	-1	2	-2	-1	0	0	0	0
13	10	3	3	3	-3	0	0	0	0
13	11	6	20	20	-6	0	0	0	0
13	12	-11	87	91	7	0	0	0	0
13	13	-63	288	310	54	1	0	0	0
13	14	1370	993	1096	-1355	3	0	0	0
13	15	32508	10160	10497	-32222	2	-19	0	0
13	16	444169	251623	252142	-441540	-130	-919	0	0
14	-16	51333	-91001	58633	-3085	81	-342	0	0
14	-15	139182	-144700	134276	117020	34	381	0	0
14	-14	4673	-19262	159	18109	-183	681	0	0
14	-13	-1552	1096	728	7305	-148	340	0	0
14	-12	2971	-647	-1058	4113	211	80	0	0
14	-11	2980	722	-2180	3363	13	-57	0	0
14	-10	1625	1343	-1867	1559	-12	-2	0	0
14	-9	430	932	-1071	330	-2	0	0	0
14	-8	-14	407	-429	-58	0	0	0	0
14	-7	-67	121	-121	-80	0	0	0	0
14	-6	-34	23	-21	-37	0	0	0	0
14	-5	-11	1	0	-12	0	0	0	0
14	-4	-3	-1	1	-3	0	0	0	0
14	-3	-2	3	3	2	0	0	0	0
14	-2	-15	7	8	15	0	0	0	0
14	-1	-66	-3	0	68	0	0	0	0
14	10	-214	-113	-103	230	0	0	0	0
14	11	-510	-490	-485	587	0	2	0	0
14	12	-1554	616	491	1824	-4	4	0	0
14	13	-19794	35721	34854	20405	7	3	0	0
14	14	-369784	399524	394854	369754	659	-28	0	0
15	-16	76130	57494	-48328	63409	1210	-322	0	0
15	-15	77924	84897	-99883	70702	-284	-52	0	0
15	-14	5168	6096	-15635	6321	-140	-31	0	0
15	-13	2418	4854	-7942	77	-4	113	0	0
15	-12	-24	4931	-5919	-1817	34	-4	0	0
15	-11	-1394	2785	-2841	-2106	-2	-11	0	0
15	-10	-1152	877	-788	-1356	0	-3	0	0
15	-9	-540	100	-51	-579	0	-1	0	0
15	-8	-171	-51	67	-174	0	0	0	0
15	-7	-37	-36	39	-36	0	0	0	0
15	-6	-4	-13	13	-4	0	0	0	0
15	-5	0	-3	3	0	0	0	0	0
15	-4	-3	-1	-1	3	0	0	0	0
15	-3	-7	-10	-10	8	0	0	0	0
15	10	-7	-47	-48	10	0	0	0	0
15	11	56	-160	-170	-46	0	0	0	0
15	12	382	-375	-429	-366	-2	0	0	0
15	13	1242	-536	-737	-1287	-3	-2	0	0
15	14	796	-1378	-1892	-1240	-4	-7	0	0
15	15	-27926	-24536	-25249	26076	-1	-10	0	0
15	16	-222705	-262795	-261368	216650	65	-112	0	0
16	-16	186	76882	-77649	-17284	-290	788	0	0
16	-15	-7997	25211	-27353	-20877	13	-6	0	0
16	-14	-6967	6885	-4491	-12757	-50	23	0	0
16	-13	-7605	1781	313	-9503	11	15	0	0
16	-12	-4466	-1095	2016	-4739	11	-5	0	0
16	-11	-1553	-1314	1597	-1496	5	-1	0	0
16	-10	-287	-680	740	-238	2	0	0	0
16	-9	18	-230	237	35	0	0	0	0
16	-8	34	-54	54	38	0	0	0	0
16	-7	14	-8	8	15	0	0	0	0
16	-6	0	0	0	4	0	0	0	0
16	-5	0	-2	-2	0	0	0	0	0
16	-4	6	-7	-7	-6	0	0	0	0
16	-3	32	-12	-14	-32	0	0	0	0
16	-2	115	15	6	-121	0	0	0	0
16	-1	286	200	181	-322	0	-1	0	0
16	10	424	793	794	-564	0	-2	0	0
16	11	50	1767	1977	-437	3	-3	0	0
16	12	-1007	414	1405	317	0	-3	0	0
16	13	2418	-27428	-24754	-2826	0	15	0	0
16	14	32427	-71878	-65763	-30746	194	428	0	0

Table A-6. (Cont.)
e) Jupiter on Saturn

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		(SECONDS OF ARC)		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	1156	0	950400	0	0	0	200521	0
0	1	-306	10739	70528	90396	0	0	15968	18985
0	2	3733	-2255	4519	7582	4899	-5148	1152	1650
0	3	-1681	-5	232	-1571	-1435	-466	93	-300
0	4	-65	145	171	-132	-260	96	41	-36
0	5	-2	0	1	-16	-27	-6	2	-5
0	6	0	1	0	-1	-3	0	0	0
1	-7	2	0	-5	2	0	6	1	0
1	-6	-5	3	-49	32	-6	106	13	3
1	-5	-130	-80	-516	335	243	1869	225	-2
1	-4	-2301	-8192	3690	1208	6605	24968	4611	-707
1	-3	194697	282343	107749	-42120	186172	519891	47726	-7959
1	-2	-141989	4243751	-1164270	77218	-129044	4262357	-246375	17517
1	-1	3331	62725	322911	1768082	3377	301039	42769	370907
1	0	116207	-10335	-10443	32751	115993	9965	-4676	6857
1	1	89	486	-936	634	6563	1350	-332	815
1	2	-82	-395	332	-84	360	-322	57	40
1	3	-16	2	26	-24	5	-38	7	-1
1	4	-1	5	8	-1	-2	1	2	0
2	-11	0	0	0	0	-3	1	0	0
2	-10	0	0	0	0	-39	16	2	6
2	-9	1	0	0	0	-521	212	31	76
2	-8	3	3	-8	0	-7073	2860	393	975
2	-7	-73	-222	-189	66	-97179	39208	4957	12297
2	-6	-4006	-12151	-5475	2310	-1386616	560881	59092	146535
2	-5	-24217273	10282561	240134	457374	-24581787	10236938	45909	134607
2	-4	-6514867	-814277	387201	-3170256	-7860936	-226431	22140	-811482
2	-3	187389	187593	-159271	129451	-265720	199043	-32083	-23904
2	-2	126342	295782	-282337	123088	102961	306524	-60506	22977
2	-1	-25161	8231	-2896	26424	-19594	25512	-2447	6058
2	0	2171	-293	-442	45	1139	1375	-295	-94
2	1	104	-44	27	91	158	53	-9	23
2	2	-5	-8	10	2	11	-7	1	1
2	3	0	0	1	0	1	-1	0	0
3	-11	0	0	-1	-2	1	-2	-1	-1
3	-10	-3	3	-17	-24	8	-23	-7	-5
3	-9	20	-12	-207	-263	7	-265	-71	-49
3	-8	-1585	-156	-2527	-2655	-2940	-1677	-712	-455
3	-7	-52733	-20458	-4858	-38293	-51076	-17735	-815	-8274
3	-6	25114	43525	-23636	6033	20816	44941	-4705	831
3	-5	4011	33098	-28907	1377	3387	38029	-6014	480
3	-4	-18054	43104	-44708	-21621	-20790	47338	-9383	-4210
3	-3	-53502	38506	-41591	-56754	-54406	41189	-9019	-12063
3	-2	1609	1636	-2676	559	-1511	3988	-813	-202
3	-1	-919	199	114	855	-1036	455	-7	162
3	0	104	21	-36	23	46	52	-11	-2
3	1	3	-4	1	4	6	1	0	1
4	-14	0	0	3	-3	5	5	1	-1
4	-13	0	0	36	-35	46	47	12	-12
4	-12	0	0	442	-429	390	396	132	-129
4	-11	5	9	5252	-5132	2198	2165	1328	-1300
4	-10	-22100	-22876	61105	-60576	-22029	-22692	13019	-12813
4	-9	-10199	-37317	54444	-18938	-14855	-41770	12001	-4487
4	-8	79	-1813	5641	-1457	-1837	-6574	1601	-461
4	-7	-3777	4035	-3346	-4165	-4316	3344	-637	-857
4	-6	-6654	2499	-1892	-7733	-7761	2547	-438	-1569
4	-5	-13012	-2536	3805	-14885	-14255	-3091	711	-3091
4	-4	-14337	-12919	14090	-16056	-15131	-12975	2988	-3458
4	-3	-539	1317	-1111	-1010	-1394	585	-157	-305
4	-2	38	19	-36	18	-55	43	-9	-7
4	-1	-50	21	-5	28	-55	25	-1	5
4	0	6	1	-2	2	2	3	-1	0
5	-15	0	0	0	0	-1	0	0	0
5	-14	-2	-1	2	1	-4	-2	1	0
5	-13	-26	-18	33	-3	-34	-30	7	-1
5	-12	-104	-515	432	-30	-111	-516	92	-6
5	-11	-254	194	-249	-259	-275	143	-49	-55
5	-10	-420	202	-211	-452	-469	209	-46	-97
5	-9	-746	-9	47	-803	-837	-24	6	-169
5	-8	-1246	-704	865	-1315	-1377	-833	169	-275
5	-7	-1247	-2045	2544	-1270	-1336	-2394	508	-277
5	-6	-48	-4864	5797	223	50	-5314	1198	20
5	-5	3272	-5795	6564	3553	3219	-6082	1411	752
5	-4	-780	-102	292	-776	-598	-444	99	-144
5	-3	-1	41	-36	-17	-32	11	-4	-7
5	-2	-5	-3	2	-5	-8	-3	0	-1
5	-1	-2	2	-1	1	-3	2	0	0

Table A-6. (Cont.)
e) Jupiter on Saturn

6	-18	0	0	0	0	-1	0	0
6	-17	1	-2	-1	0	-7	0	0
6	-16	12	-27	0	0	-50	1	0
6	-15	174	-409	198	88	-421	42	19
6	-14	342	-286	198	228	-330	43	49
6	-13	91	-31	31	56	-68	8	13
6	-12	-47	-25	27	-42	-35	6	-8
6	-11	-71	-86	92	-69	-98	19	-15
6	-10	-46	-235	263	-33	-266	54	-8
6	-9	159	-502	560	230	-560	115	43
6	-8	729	-680	752	959	-739	159	190
6	-7	1968	-435	419	2380	-439	96	491
6	-6	2407	715	-742	2727	2518	-156	586
6	-5	-42	-417	443	29	99	89	22
6	-4	-30	9	1	-31	-22	2	-6
6	-3	1	-2	1	0	-3	0	0
6	-2	-1	0	0	-1	0	0	0
6	17	1	-2	2	1	-2	0	0
7	-17	3	-2	2	3	-2	0	1
7	-16	0	-1	1	-1	-2	0	0
7	-15	-4	-4	3	-3	-5	1	-1
7	-14	-3	-9	8	-3	-4	2	-1
7	-13	3	-18	18	4	-20	4	1
7	-12	25	-32	33	29	-35	7	6
7	-11	92	-39	36	108	-40	8	22
7	-10	229	23	-52	268	38	-9	55
7	-9	375	266	-365	435	317	-72	91
7	-8	369	810	-985	407	390	-203	88
7	-7	-56	999	-1126	-32	1042	-242	-6
7	-6	208	-70	46	229	-12	3	48
7	-5	-11	-18	21	-6	-18	4	0
7	-4	0	1	0	0	0	0	0
7	17	1	0	0	1	0	0	0
8	-20	1	0	0	2	0	0	0
8	-19	2	1	-1	2	1	0	0
8	-18	1	1	-1	1	1	0	0
8	-16	0	0	1	1	0	0	0
8	-15	3	-2	1	2	-2	0	1
8	-14	7	0	0	8	0	0	2
8	-13	16	8	-11	18	10	-2	4
8	-12	27	39	-48	27	45	-10	6
8	-11	11	110	-133	2	125	-27	1
8	-10	-90	205	-244	-129	226	-51	-25
8	-9	-328	245	-280	-398	262	-60	-82
8	-8	-406	75	-100	-454	95	-22	-98
8	-7	59	97	-110	52	102	-24	8
8	-6	10	-10	8	12	-4	1	3
8	-5	-1	0	0	0	0	0	0
8	17	-1	1	-1	-1	1	0	0
9	-17	0	0	0	1	0	0	0
9	-16	0	-1	-2	2	-1	0	0
9	-15	1	3	-4	1	4	-1	0
9	-14	-2	9	-10	-4	10	-2	-1
9	-13	-17	18	-19	-22	19	-4	-4
9	-12	-53	17	-15	-67	16	-3	-13
9	-11	-110	-23	37	-133	-29	7	-27
9	-10	-146	-126	153	-169	-136	31	-36
9	-9	-73	-159	175	-89	-164	38	-19
9	-8	-42	41	-40	-49	32	-7	-11
9	-7	7	5	-6	7	5	-1	1
9	-6	0	-1	1	0	0	0	0
9	17	-3	-4	4	-3	-4	1	-1
10	-17	1	0	-1	-1	1	0	0
10	-16	4	-1	-2	-6	4	-1	-1
10	-15	-5	0	1	-6	-5	0	-1
10	-14	-11	-7	9	-12	-12	2	-3
10	-13	-14	-25	33	-15	-29	7	-3
10	-12	0	-57	70	4	-64	14	0
10	-11	43	-81	95	53	-87	20	11
10	-10	58	-48	57	63	-54	12	14
10	-9	-26	-16	19	-26	-19	4	-5
10	-8	-2	5	-5	-2	-3	-1	-1
10	16	0	0	0	1	0	0	0
10	17	13	-5	5	13	-5	1	3
10	18	0	0	0	1	0	0	0
11	-19	0	1	-1	0	1	0	0

Table A-6. (Cont.)
e) Jupiter on Saturn

11	-17	1	2	3	-2	1	3	1	0
11	-16	0	12	14	-1	0	12	3	0
11	-15	2	-7	9	4	3	-7	2	1
11	-14	12	-10	12	15	14	-11	2	3
11	-13	29	-6	6	36	32	-6	1	7
11	-12	43	11	-14	50	46	12	-3	11
11	-11	27	19	-20	31	30	18	-4	7
11	-10	5	-15	15	6	7	-14	3	2
11	-9	-3	-1	1	-3	-3	-1	0	-1
11	16	0	-1	-2	0	0	1	0	0
11	17	1	36	-36	1	1	36	-7	0
11	18	0	1	-2	0	0	3	-1	0
12	-19	-1	0	0	-1	-1	0	0	0
12	-18	0	0	0	1	-1	0	0	0
12	-17	-6	1	1	8	-8	0	0	2
12	-16	-24	-7	-6	26	-24	-7	-1	5
12	-15	7	5	-8	10	6	6	-1	2
12	-14	6	14	-18	7	7	16	-4	2
12	-13	0	22	-25	-1	0	23	-5	0
12	-12	-4	13	-16	-5	-4	15	-3	-1
12	-11	8	0	-2	8	8	1	0	2
12	-10	0	-2	2	0	1	-2	0	0
12	16	2	1	0	-4	-2	0	0	-1
12	17	-70	-18	18	-70	-70	-18	4	-15
12	18	-2	0	1	-4	-6	-1	0	-1
12	19	0	0	0	0	-1	0	0	0
13	-19	0	0	0	0	0	-1	0	0
13	-18	0	0	-1	0	0	-1	0	0
13	-17	1	-13	-15	-2	3	-15	-3	-1
13	-16	20	-33	-34	-19	19	-33	-7	-4
13	-15	-7	6	-9	-10	-7	4	-2	-2
13	-14	-11	3	-3	-12	-11	3	-1	-3
13	-13	-6	0	0	-7	-7	1	0	-2
13	-12	1	5	-4	0	1	5	-1	0
13	-11	2	0	1	1	2	1	0	0
13	15	0	1	1	0	0	0	0	0
13	16	-2	1	7	2	1	-4	1	0
13	17	55	-96	96	55	54	-96	20	11
13	18	1	-3	5	3	5	-8	2	1
13	19	0	0	0	0	0	-1	0	0
14	-18	0	0	0	-1	1	1	0	0
14	-17	17	6	7	-18	18	8	2	-4
14	-16	29	28	28	-30	30	28	6	-6
14	-15	-4	-5	8	-6	-2	-4	2	-1
14	-14	-1	-2	3	-1	-1	-2	1	0
14	-13	-2	2	0	-2	-2	2	0	0
14	-12	0	2	0	0	0	2	0	0
14	-11	-1	0	0	0	-1	1	0	0
14	15	-1	0	0	1	-1	0	0	0
14	16	0	-2	-4	8	5	2	0	1
14	17	86	80	-80	86	86	80	-17	18
14	18	2	2	-4	5	7	7	-1	2
14	19	0	0	0	0	1	1	0	0
15	-18	0	0	1	1	-1	1	0	0
15	-17	-12	16	16	13	-13	16	3	3
15	-16	-19	15	16	20	-20	16	3	4
15	-15	0	-1	3	3	-1	-1	0	1
15	-14	-3	-1	1	0	-3	-1	0	0
15	-13	-2	0	0	0	-2	0	0	0
15	-12	-1	-1	0	0	-1	-1	0	0
15	12	1	0	0	1	1	0	0	0
15	14	0	0	0	0	0	-1	0	0
15	15	0	-1	0	0	0	-1	0	0
15	16	-1	2	-6	-5	-4	4	-1	-1
15	17	-57	48	-48	-57	-57	48	-10	-12
15	18	-2	1	-3	-3	-5	4	-1	-1
16	-18	0	0	0	1	-1	0	0	0
16	-17	-17	-2	-2	17	-17	-2	0	4
16	-16	-4	-3	-3	6	-5	-3	-1	1
16	-15	-1	-4	0	1	-1	-4	0	0
16	-14	0	-3	0	0	0	-3	0	0
16	-13	1	-1	0	0	1	-2	0	0
16	-12	1	0	0	0	1	-1	0	0
16	12	0	1	-1	0	0	1	0	0
16	14	1	0	0	0	1	0	0	0
16	15	1	0	0	0	1	0	0	0
16	16	-4	0	1	-6	-5	0	0	-1
16	17	-15	-7	7	-15	-15	-7	1	-3
16	18	0	0	0	-1	-1	-1	0	0

Table A-6. (Cont.)
 Secular Terms
 e) Jupiter on Saturn

J	DX		DY		DZ	
	COS	SIN	COS	SIN	COS	SIN
	(IN UNITS OF $10^{**}(-16)$) (TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
0	1082707325	0	-1748071321	0	-35335389	0
1	30336596	16455863	16244568	50611567	419708419	299265120
2	-358636175	581781678	-580865311	-358068306	11753799	8383022
3	-30170121	48864868	-48826357	-30146265	493774	352215
4	-2254263	3649183	-3647265	-2253075	24585	17538
5	-164455	266148	-266043	-164390	1345	959
6	-11940	19321	-19315	-11937	78	56
7	-867	1404	-1403	-867	5	3
8	-63	102	-102	-63	0	0
9	-5	7	-7	-5	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	484288	0	75154	0	-130840	0
1	-8640529	-5355925	2677962	-4320264	1554094	1108117
2	-121019	-74995	74995	-121019	43522	31041
3	-3389	-2101	3151	-5084	1828	1304
4	-128	-79	156	-253	91	65
5	-5	-3	8	-14	5	4
6	0	1	1	-1	0	0
7	0	-1	0	0	0	0
8	-1	0	0	0	0	0
9	0	0	1	0	0	0
10	1	1	-1	0	0	0
11	-1	0	0	0	0	0
13	1	1	-1	0	0	0
14	-1	-1	0	1	0	0
15	1	0	0	0	0	0
16	0	0	0	-1	0	0
17	0	-1	0	0	0	0
18	0	0	0	1	0	0
19	0	0	-1	0	0	0

Table A-6. (Cont.)

Periodic Terms

f) Uranus on Saturn

		DX		DY		DZ		U/CORR(1)	
		(IN UNITS OF 10 ⁻¹¹)		(IN UNITS OF 10 ⁻¹¹)		(IN UNITS OF 10 ⁻¹¹)		(IN UNITS OF 10 ⁻¹¹)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	2693747	0	-755054	0	-447884	0	-101	0
0	1	-11904101	90686	-75738	-11845819	0	0	0	0
0	2	1348406	-740107	739587	1346702	-4987	-104905	-1	-23
0	3	55206	-26661	26705	55214	897	-1298	0	-1
0	4	20A3	-942	943	20A5	38	-142	0	0
0	5	57	-24	24	57	2	-7	0	0
1	-9	0	1	1	0	0	0	0	0
1	-8	-2	18	18	2	0	0	0	0
1	-7	-76	244	244	26	0	0	0	0
1	-6	-373	3389	3387	373	-3	3	0	0
1	-5	-5412	47262	47244	5411	-54	51	0	0
1	-4	-80743	460990	460667	80714	-1100	1051	0	0
1	-3	-1254130	9153993	9147755	1254974	-24453	28403	-4	4
1	-2	-21644924	118441299	118268007	21641251	-1431298	732588	-309	158
1	-1	17929404	17243917	18915053	-21662194	437444	1683949	95	344
1	0	472961A0	-243755282	243478583	46189317	-2367740	-2836487	-517	-614
1	1	-11912120	-22923653	22904441	-11887643	-788125	-806490	-170	-17
1	2	-907606	-1936721	1936157	-901946	-70088	-8497	-4	-2
1	3	-652A0	-86216	86188	-65223	-861	-311	0	0
1	4	-6448	-5789	5787	-6446	-44	-16	0	0
1	5	-332	-399	399	-332	-2	0	0	0
1	6	-24	-28	28	-24	0	0	0	0
1	7	-2	-2	2	-2	0	0	0	0
2	-10	-2	0	0	2	0	0	0	0
2	-9	-74	-11	-11	24	0	0	0	0
2	-8	-330	-148	-148	330	0	0	0	0
2	-7	-6486	-2002	-2002	4484	0	0	0	0
2	-6	-60786	-26877	-26866	60711	4	2	0	0
2	-5	-8117A6	-354515	-354313	811298	127	471	0	0
2	-4	-104379A7	-4452725	-4448876	10428763	3203	11175	1	2
2	-3	-115525P28	-46759329	-46686625	115322033	44529	357024	10	77
2	-2	-1532910A6	-17428087	-16959476	146786064	-1281409	106405	-277	23
2	-1	4109302A6	179172479	-175708889	411127835	-4285074	2658419	-927	575
2	0	23217A8A6	32449275	-32459014	232043425	95183	-1704587	207	-349
2	1	1097A972	585460	-586399	10972429	4549	-71283	1	-15
2	2	644403	22797	-22807	644186	710	-2762	0	-1
2	3	41335	1023	-1024	41324	34	-129	0	0
2	4	27A9	52	-52	276A	2	-7	0	0
2	5	190	3	-3	190	0	0	0	0
2	6	13	0	0	13	0	0	0	0
3	-10	0	5	5	0	0	0	0	0
3	-9	-5	66	66	5	0	0	0	0
3	-8	-44	889	889	44	0	0	0	0
3	-7	-243	11963	11958	244	15	5	0	0
3	-6	3470	159152	159062	-3461	294	86	1	0
3	-5	181534	2080924	2059268	-181073	5867	1554	7	0
3	-4	5125847	24467497	244636959	-5103201	120756	32957	24	7
3	-3	10A096977	219741110	219751526	-106849582	229522	882173	48	191
3	-2	-491277839	-410672210	-345624999	553524677	9478070	25837778	2050	5587
3	-1	-3P7421008	-688741262	-688256924	-388226645	-1611950	-27059783	-349	-499
3	0	472499655	326627132	-326329469	472098454	-1354029	550208	-293	119
3	1	27418738	19239207	-19228280	27403773	-38226	13369	-8	3
3	2	1767744	1232431	-1231917	1746536	-1403	587	0	0
3	3	11A6A6	82495	-82468	11A618	-80	29	0	0
3	4	8004	5669	-5667	8007	-4	2	0	0
3	5	559	396	-396	559	0	0	0	0
3	6	40	28	-28	40	0	0	0	0
3	7	3	2	-2	3	0	0	0	0
4	-10	3	9	9	-3	0	0	0	0
4	-9	37	105	105	-38	0	0	0	0
4	-8	476	1264	1265	-475	3	-8	0	0
4	-7	5483	14275	14293	-5480	37	-147	0	0
4	-6	53745	142430	142995	-52867	749	-2437	0	-1
4	-5	244014	1057A86	1076296	-239192	7429	-36293	2	-8
4	-4	-5227112	2170300	3006580	5194136	10245	29514	2	6
4	-3	-9459617	5811670	21727872	-5603033	-1022648	180801	-271	39
4	-2	242376A0	-9318906	7355392	25411158	-184203	1121195	-40	243
4	-1	4701746	-28269816	28265668	4694167	-88567	-214520	-19	-46
4	0	51A071	-633193	633480	517632	-20034	-1790	-4	-2
4	1	35199	-22424	22433	35178	-526	-367	0	0
4	2	2323	-1150	1151	2322	-24	-15	0	0
4	3	158	-A6	66	158	-1	0	0	0
4	4	11	-4	4	11	0	0	0	0
5	-11	4	0	0	-4	0	0	0	0
5	-10	34	-2	-3	-33	0	0	0	0
5	-9	378	-57	-55	-380	-4	-4	0	0
5	-8	3884	-747	-722	-3904	-69	-56	0	0
5	-7	37944	-8029	-7633	-33461	-1048	-702	0	0
5	-6	170784	-39410	-33678	-184134	-12495	-5767	-3	-1
5	-5	-445933	617673	641561	118708	4948	-4999	2	-1
5	-4	-6901308	552746	-2644272	1428320	-38441	206817	-8	45
5	-3	-5019363	-1548093	9849136	3209071	-880920	-412924	-190	-89
5	-2	14507265	4695854	-4777987	14534189	-32254	126467	-7	27
5	-1	6144608	-5511001	5508296	6141302	12682	-57800	3	-12
5	0	301258	-255806	255507	301124	-274	-1930	0	0
5	1	18026	-14540	14536	18020	2	-74	0	0
5	2	1168	-930	929	1167	0	-4	0	0
5	3	79	-62	62	79	0	0	0	0
5	4	5	-4	4	5	0	0	0	0
6	-12	0	-2	-2	0	0	0	0	0
6	-11	5	-11	-11	-4	0	0	0	0
6	-10	17	-128	-131	-18	2	0	0	0
6	-9	94	-1255	-1267	-120	-42	28	0	0
6	-8	90	-9620	-9952	-456	-464	403	0	0
6	-7	1203	-41718	-49381	-4227	-4166	-1	0	1
6	-6	128444	136477	-18075	-167503	-1082	-6485	0	-1
6	-5	270120	1482733	-495718	343986	60730	21210	13	5
6	-4	-260908	2388344	-2608682	-3341563	-77606	122948	-17	27
6	-3	-1810180	-1255436	2205877	3811276	303847	470188	66	102
6	-2	-4571225	-6808700	6813140	-4573295	-47061	-40701	-9	-9

Table A-6. (Cont.)

f) Uranus on Saturn

1	-1	2265824	-673654	673173	2263677	-10287	8805	-2	1
1	0	137883	-38866	38867	137802	-304	149	0	0
1	1	8908	-2459	2458	8905	-13	7	0	0
1	2	599	-164	164	599	0	0	0	0
1	3	41	-11	11	41	0	0	0	0
1	4	3	0	0	3	0	0	0	0
7	-13	-2	0	-1	2	0	0	0	0
7	-12	-2	-4	-4	2	0	0	0	0
7	-11	-41	-16	-18	44	0	2	0	0
7	-10	-408	-134	-158	412	8	27	0	0
7	-9	-2918	-673	-965	2988	133	267	0	0
7	-8	-4793	-2134	-5965	13625	1310	1613	0	0
7	-7	51160	-16557	-48961	17485	-1933	28	0	0
7	-6	400415	27454	75431	325328	11101	-18800	2	-4
7	-5	-318510	712592	-554770	-30230	25100	32924	5	7
7	-4	-504714	-135179	451737	-478815	-60254	20222	-13	4
7	-3	626485	-301105	289178	654320	3069	23934	1	5
7	-2	44753	-506875	506787	45695	-2121	-4328	0	-1
7	-1	9236	-18475	18470	9226	-294	-98	0	0
7	0	86	-950	950	86	-8	-6	0	0
7	1	46	-58	58	46	0	0	0	0
7	2	3	-4	4	3	0	0	0	0
8	-15	1	0	0	0	0	0	0	0
8	-14	-2	2	2	2	0	0	0	0
8	-13	-5	-3	-2	3	0	0	0	0
8	-12	-4	11	14	7	1	0	0	0
8	-11	-79	135	131	98	14	0	0	0
8	-10	-796	804	868	599	141	-31	0	0
8	-9	-767	1973	3646	3334	753	-363	0	0
8	-8	2567	-21196	7373	19061	-178	798	0	0
8	-7	37555	-140072	123224	9364	-5917	-5501	-1	-1
8	-6	223802	144507	-100451	233177	13576	-6589	3	-1
8	-5	-300725	135351	-172995	-72513	520	16545	0	4
8	-4	-145507	-587030	291670	-46168	-2945	-8	-8	-2
8	-3	383312	87004	-88296	384391	1233	2763	0	1
8	-2	136967	-146588	146506	136887	209	-1140	0	0
8	-1	6966	-7085	7082	6962	-4	-37	0	0
8	0	424	-419	419	424	0	-1	0	0
8	1	28	-27	27	28	0	0	0	0
8	2	2	-2	2	2	0	0	0	0
8	16	-1	0	0	1	0	0	0	0
9	-16	0	-2	0	0	0	0	0	0
9	-15	5	3	0	0	0	0	0	0
9	-14	-7	4	2	6	0	0	0	0
9	-13	2	-7	-2	-5	0	0	0	0
9	-12	53	38	53	-42	2	-8	0	0
9	-11	222	178	300	-231	7	-69	0	0
9	-10	298	1674	1674	-505	-72	-334	0	0
9	-9	-8130	-4437	8361	-2808	315	155	0	0
9	-8	-47783	-25899	16150	-44566	-2584	1773	-1	0
9	-7	75868	-79978	81688	63690	-1422	-5841	0	-1
9	-6	46077	101244	-80582	49269	8176	912	1	0
9	-5	-464977	36175	-26187	-93218	-2586	5099	-1	1
9	-4	-1831	-39849	51072	40367	5892	6193	1	1
9	-3	-64966	-81822	81875	-64987	-814	-530	0	0
9	-2	14532	-7712	7706	14517	-112	80	0	0
9	-1	935	-456	456	934	-3	2	0	0
9	0	61	-29	29	61	0	0	0	0
9	1	4	-2	2	4	0	0	0	0
9	16	-6	0	0	6	0	0	0	0
10	-16	6	-5	0	-4	0	0	0	0
10	-15	9	17	5	6	0	0	0	0
10	-14	-17	-2	-6	11	0	0	0	0
10	-13	22	-35	-17	-32	-4	-2	0	0
10	-12	80	-54	-45	-137	-32	-9	0	0
10	-11	-144	-11	-162	-760	-141	-4	0	0
10	-10	-3090	2825	-848	-3896	99	-117	0	0
10	-9	-14194	15381	-15027	-10804	663	1169	0	0
10	-8	-24536	-38242	34661	-27366	-2511	59	-1	0
10	-7	45457	-10982	13641	42818	904	-2456	0	-1
10	-6	-7000	32380	-28334	-843	1454	1360	0	0
10	-5	-14659	-4418	14047	-15000	-1704	866	0	0
10	-4	13317	-7961	7810	13771	159	387	0	0
10	-3	142	-9038	9036	142	-44	-77	0	0
10	-2	118	-355	355	118	-5	-2	0	0
10	-1	9	-19	19	9	0	0	0	0
10	0	0	-1	1	0	0	0	0	0
10	16	-20	-16	-16	20	0	0	0	0
11	-16	25	-4	9	-8	0	2	0	0
11	-15	0	59	-12	21	0	0	0	0
11	-14	-39	-23	-31	12	-2	1	0	0
11	-13	2	-51	-57	-6	-7	14	0	0
11	-12	15	147	-395	-16	-16	56	0	0
11	-11	818	1749	-1837	105	-40	-55	0	0
11	-10	4978	6948	-5773	4516	511	-77	0	0
11	-9	-18543	7449	-8054	-17398	-209	1062	0	0
11	-8	-779	-21394	20678	-1663	-984	-624	0	0
11	-7	13600	5275	-4183	13770	701	-497	0	0
11	-6	-8392	5435	-5894	-2188	100	544	0	0
11	-5	-4130	-262	7606	945	-1142	-134	0	0
11	-4	9978	1405	-1435	10005	64	47	0	0
11	-3	3421	-4374	4372	3419	3	-26	0	0
11	-2	179	-219	219	178	0	0	0	0
11	-1	11	-13	13	11	0	0	0	0
11	15	-4	-1	-1	4	0	0	0	0
11	16	-27	-97	-97	27	0	0	0	0
12	-16	83	32	26	15	0	7	0	0
12	-15	-62	149	-85	25	0	0	0	0
12	-14	-53	-32	-28	17	4	5	0	0
12	-13	119	-18	-41	176	21	13	0	0
12	-12	900	-128	-127	853	-28	116	0	0
12	-11	3139	-913	1051	2736	18	-716	0	0
12	-10	1343	-8626	8266	-1647	192	436	0	0
12	-9	-9836	-1743	1376	-9650	-377	381	0	0
12	-8	3817	-6084	6085	3483	-159	-369	0	0
12	-7	2181	3304	-2874	2246	238	-1	0	0
12	-6	-1358	756	88	-2146	-53	145	0	0
12	-5	115	-935	1075	505	100	75	0	0
12	-4	-988	-1071	1072	-989	-14	-6	0	0
12	-3	108	-95	94	108	-1	1	0	0
12	-2	7	-6	6	7	0	0	0	0
12	-1	0	-1	1	0	0	0	0	0
12	14	-15	-12	-12	15	0	0	0	0
12	15	53	-313	-313	-54	3	-1	0	0

Table A-6. (Cont.)
f) Uranus on Saturn

13	-16	200	129	39	137	0	6	0	0
13	-15	-241	184	-133	-116	2	-3	0	0
13	-14	-42	-108	98	19	8	-7	0	0
13	-13	80	-443	377	175	2	13	0	0
13	-12	24	-1316	1174	-53	-88	-29	0	0
13	-11	3845	308	-168	3740	126	-171	0	0
13	-10	-1799	4366	-4376	-1647	137	211	0	0
13	-9	-2582	-2475	2360	-2600	-191	38	0	0
13	-8	1820	-768	825	1751	23	-112	0	0
13	-7	-67	932	-835	61	49	34	0	0
13	-6	-343	-81	263	-364	-39	26	0	0
13	-5	265	-189	188	272	4	5	0	0
13	-4	-9	-163	163	-9	0	-1	0	0
13	-3	1	-7	7	1	0	0	0	0
13	-2	-4	0	0	4	0	0	0	0
13	-1	-41	-33	-33	41	0	0	0	0
13	0	496	-424	-423	-498	10	2	0	0
14	-16	73	293	-63	92	-20	-9	0	0
14	-15	-756	42	19	-688	-3	-5	0	0
14	-14	-270	-148	185	-189	6	0	0	0
14	-13	-502	-189	156	-438	-21	34	0	0
14	-12	551	-1632	1608	494	-63	-73	0	0
14	-11	1849	1288	-1224	1847	112	-42	0	0
14	-10	-1490	1012	-1028	-1447	-2	97	0	0
14	-9	-209	-1018	997	-229	-53	-23	0	0
14	-8	457	105	-81	463	21	-20	0	0
14	-7	-207	155	-150	-19	4	13	0	0
14	-6	-129	73	229	47	-35	0	0	0
14	-5	287	18	-19	288	3	0	0	0
14	-4	110	-170	170	110	0	0	0	0
14	-3	6	-9	9	6	0	0	0	0
14	-2	0	-1	-1	0	0	0	0	0
14	-1	3	0	0	-3	0	0	0	0
14	0	-3	0	0	3	0	0	0	0
14	1	33	-73	-73	-33	0	0	0	0
14	2	1906	-53	-48	-1908	14	11	0	0
15	-16	-594	1361	-1206	-593	-27	1	0	0
15	-15	-1048	225	-105	-1047	0	-3	0	0
15	-14	-227	151	-98	-214	12	13	0	0
15	-13	-652	-444	428	-651	-39	20	0	0
15	-12	796	-740	746	769	-8	-57	0	0
15	-11	341	844	-828	351	47	11	0	0
15	-10	-554	-2	-8	-547	-17	25	0	0
15	-9	104	-238	238	96	-8	-13	0	0
15	-8	69	80	-71	70	7	0	0	0
15	-7	-31	17	-5	-44	0	3	0	0
15	-6	2	-20	22	6	2	0	0	0
15	-5	-16	-15	15	-16	0	0	0	0
15	-4	0	-1	1	0	0	0	0	0
15	-3	-2	0	0	2	0	0	0	0
15	-2	3	-5	-5	-3	0	0	0	0
15	-1	9	7	7	-9	0	0	0	0
15	0	5	-32	-32	-5	0	0	0	0
15	1	292	-452	-451	-293	0	0	0	0
15	2	2654	-262	-241	-2650	0	28	0	0
16	-16	408	2385	-2312	235	-10	-11	0	0
16	-15	-300	348	-332	-371	7	-4	0	0
16	-14	-341	233	-236	-347	5	19	0	0
16	-13	-284	-455	444	-291	-27	-2	0	0
16	-12	451	-77	82	445	11	-22	0	0
16	-11	-64	291	-289	-59	11	12	0	0
16	-10	-119	-83	80	-119	-8	3	0	0
16	-9	50	-30	31	49	0	-3	0	0
16	-8	0	22	-20	4	1	0	0	0
16	-7	-7	-1	5	-8	0	0	0	0
16	-6	5	-4	4	5	0	0	0	0
16	-5	0	-3	3	0	0	0	0	0
16	-4	0	2	2	0	0	0	0	0
16	-3	-6	-5	-5	6	0	0	0	0
16	-2	17	-8	-9	-18	0	0	0	0
16	-1	0	27	27	0	-1	1	0	0
16	0	-51	-86	-87	51	0	-2	0	0
16	1	-58	-828	-832	58	2	1	0	0
16	2	1037	-626	-603	-1035	-5	31	0	0

Table A-6. (Cont.)

f) Uranus on Saturn

		HD7				D (LONG.)			
		(IN UNITS OF 10**(-4))				(IN UNITS OF 10**(-9))			
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-2533	0	0	0	-533	0
0	1	1	3	773	-319	0	0	152	-67
0	2	-10	-20	29	-12	-10	-20	6	-3
0	3	0	-1	2	-1	-1	-2	0	0
1	-5	0	0	0	0	2	0	0	0
1	-4	1	0	0	-2	32	3	0	-5
1	-3	35	-4	-4	-45	427	39	5	-57
1	-2	1493	-247	-121	-1165	5893	570	60	-708
1	-1	78123	15117	5264	-27255	78495	14678	1065	-5760
1	0	6158	-7570	163	379	9542	712	212	561
1	1	4	-214	151	12	600	-579	69	72
1	2	0	-4	6	0	63	-42	6	6
1	3	0	0	0	0	3	-3	0	0
2	-6	0	0	0	0	-2	4	1	0
2	-5	-1	2	5	3	-27	48	7	3
2	-4	-36	62	98	54	-293	639	91	42
2	-3	-1149	2019	2200	1159	-3894	8632	1144	533
2	-2	-48409	112638	66616	28627	-48909	117003	14441	6066
2	-1	-7823	75916	16477	2735	-10499	87188	2799	286
2	0	731	-854	417	268	103	3847	-416	-14
2	1	8	-14	11	8	4	268	-35	0
2	2	0	0	0	0	0	20	-3	0
2	3	0	0	0	0	0	1	0	0
3	-7	0	0	0	0	1	0	0	0
3	-6	0	1	1	-1	10	2	0	-2
3	-5	11	12	16	-21	133	20	4	-20
3	-4	391	276	271	-421	1771	193	41	-755
3	-3	12457	53846	3546	-9753	23085	-138	181	-316
3	-2	200800	-114347	-54819	-97144	192327	-101620	-10247	-19415
3	-1	-163658	221679	-9197	-8237	-152382	215312	-1243	-542
3	0	-450	357	-177	-230	-8831	12332	-1288	-913
3	1	-6	5	-5	-6	-616	862	-108	-77
3	2	0	0	0	0	-45	63	-9	-6
3	3	0	0	0	0	-3	5	-1	0
4	-7	0	0	0	-1	2	-1	0	0
4	-6	7	-1	-3	-9	23	-9	-1	-4
4	-5	131	-50	-64	-142	252	-114	-20	-43
4	-4	1958	-1625	-1272	-1614	2122	-1253	-228	-356
4	-3	2168	6626	4303	-1554	2779	6591	922	-368
4	-2	8976	1003	538	-3106	9077	1377	76	-637
4	-1	-505	169	-44	-179	7	251	-18	16
4	0	-7	2	-1	-4	1	17	-2	1
4	1	0	0	0	0	0	1	0	0
5	-8	0	0	0	0	0	-1	0	0
5	-7	0	-3	-5	0	-1	-9	-2	0
5	-6	-7	-56	-61	11	-20	-91	-16	4
5	-5	-333	-634	-552	274	-261	-625	-114	50
5	-4	1382	-71	-73	-1037	1294	126	13	-213
5	-3	-1392	4020	2308	735	-1194	4124	498	150
5	-2	2172	1980	388	-312	2098	2204	58	-73
5	-1	-30	-16	8	-15	87	110	-12	9
5	0	-1	0	0	0	6	8	-1	1
5	1	0	0	0	0	0	1	0	0
6	-8	-2	-1	-1	2	-4	-1	0	1
6	-7	-24	-3	-2	26	-36	-1	0	7
6	-6	-227	58	46	201	-218	35	7	42
6	-5	58	-422	-348	-38	80	-409	-73	-13
6	-4	480	260	159	-354	593	164	28	-86
6	-3	1973	-1378	-630	-920	2008	-1300	-127	-192
6	-2	139	1173	-101	-20	252	1097	-13	8
6	-1	1	5	-3	0	16	65	-7	2
6	0	0	0	0	0	1	5	-1	0
7	-9	-1	1	1	1	-1	2	0	0
7	-8	-4	10	11	3	-4	14	3	1
7	-7	1	80	73	1	-6	77	15	1
7	-6	-143	-51	-41	125	-137	-52	-10	26
7	-5	108	-110	-90	-78	104	-102	-18	-18
7	-4	73	177	109	-53	87	171	24	-11
7	-3	161	1	5	-52	165	11	0	-11
7	-2	-5	4	-1	-2	4	5	0	1
8	-10	0	0	0	0	1	1	0	0
8	-9	4	3	3	-4	5	3	1	-1
8	-8	28	7	7	-26	27	9	2	-5
8	-7	-31	50	45	27	-31	48	9	6
8	-6	-32	-48	-38	29	-32	-45	-8	6
8	-5	45	-6	-7	-32	-42	-2	-1	-7
8	-4	-27	108	60	13	-22	110	13	3
8	-3	58	44	7	-7	57	50	1	-2
8	-2	-1	0	0	0	3	3	0	0
9	-10	2	-1	-2	-2	2	-2	0	0
9	-9	5	-10	-9	-5	6	-9	-2	-1
9	-8	17	17	15	-16	16	17	3	-3
9	-7	-22	9	9	19	-21	9	2	6
9	-6	1	-17	-13	1	0	-16	-3	0
9	-5	12	6	3	-9	13	4	1	-2
9	-4	24	-20	-9	-11	24	-19	-2	-2
9	-3	2	9	-1	0	3	8	0	0
10	-11	0	-1	-1	1	-1	-1	0	0
10	-10	-3	-3	-3	3	-3	-3	-1	1
10	-9	8	-5	-5	-8	8	-5	-1	-2
10	-8	2	10	9	-2	2	10	2	0
10	-7	-7	-2	-1	6	-7	-1	0	1

Table A-6. (Cont.)
f) Uranus on Saturn

10	-6	3	-3	-3	-2	3	-3	-1	0
10	-5	2	4	2	-1	2	4	0	0
10	-4	3	0	0	-1	3	0	0	0
11	-12	0	0	0	0	-1	0	0	0
11	-11	-1	1	1	1	-1	1	0	0
11	-10	-1	-4	-4	1	-1	-4	-1	0
11	-9	5	0	0	-4	5	0	0	-1
11	-8	-1	3	3	1	-1	3	1	0
11	-7	-1	-1	-1	1	-1	-1	0	0
11	-6	1	0	0	-1	1	0	0	0
11	-5	0	3	2	0	0	3	0	0
11	-4	2	1	0	0	2	1	0	0
12	-12	0	1	1	0	0	1	0	0
12	-11	-2	0	0	2	-2	0	0	0
12	-10	1	-2	-2	0	1	-2	0	0
12	-9	1	1	1	-1	1	1	0	0
12	-8	-1	0	0	1	-1	0	0	0
13	-12	0	1	1	0	0	1	0	0
13	-11	-1	0	0	1	-1	0	0	0
13	-10	1	-1	-1	-1	1	-1	0	0
15	17	0	-1	1	0	0	-1	0	0
16	-17	-1	0	0	1	-1	0	0	0

Table A-6. (Cont.)

Secular Terms

f) Uranus on Saturn

J	DX		DY		DZ	
	COS	SIN	COS	SIN	COS	SIN
(IN UNITS OF $10^{**}(-16)$)						
(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)						
0	-15777601	0	-28930920	0	-896218	0
1	-442060	270607	270590	-737515	10645137	8139432
2	5226176	9628502	-9613336	5217900	298114	228002
3	439650	808717	-808080	439302	12524	9580
4	32850	60394	-60363	32833	624	477
5	2396	4405	-4403	2396	34	26
6	174	320	-320	174	2	2
7	13	23	-23	13	0	0
8	0	2	-2	0	0	0

NDZ NU U/COS(J)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	8021	0	-1098	0	-3319	0
1	-143003	78047	-39023	-71500	39417	30139
2	-2003	1094	-1093	-2003	1104	844
3	-56	30	-45	-84	46	35
4	-2	1	-3	-4	2	2
5	0	0	-1	0	0	0
6	0	2	0	0	0	0
7	-1	-2	0	0	0	0
8	0	1	0	0	0	0
9	1	-1	0	0	0	0
10	1	1	0	0	0	0
11	-1	0	-1	1	0	0
13	1	0	0	0	0	0
14	-1	-1	0	-1	0	0
15	0	1	0	0	0	0
16	1	0	0	-1	0	0
17	-1	0	1	0	0	0
18	-1	0	0	0	0	0
19	1	-1	0	-1	0	0
20	0	1	0	0	0	0

Table A-6. (Cont.)
 Periodic Terms
 g) Neptune on Saturn

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	640434	0	14112	0	11064	0	2	0		
0	1	-2987553	-1382	1781	-2971098	0	0	0	0		
0	2	307573	14062	-14048	307650	-795	-5976	0	-1		
0	3	13293	479	-479	13297	-34	-220	0	0		
0	4	534	13	-13	535	-2	-10	0	0		
0	5	19	0	0	19	0	0	0	0		
1	-8	-2	-3	-3	2	0	0	0	0		
1	-7	-34	-38	-38	34	0	0	0	0		
1	-6	-476	-526	-526	476	0	0	0	0		
1	-5	-6620	-7294	-7291	6617	4	-2	0	0		
1	-4	-91991	-101021	-100968	91944	81	-43	0	0		
1	-3	-1261270	-1377039	-1375976	1260312	1980	-1059	0	0		
1	-2	-15913482	-17147213	-17121904	15890203	70782	-40548	15	-9		
1	-1	-1717271	-3371405	-3104157	1268017	3623	65373	1	14		
1	0	39342789	42127141	-42254451	39345961	125115	-190543	27	-41		
1	1	2805848	4376026	-4371729	2804168	53652	-54696	12	-12		
1	2	155722	265960	-265811	155657	1467	-1572	0	0		
1	3	9855	17442	-17435	9851	64	-69	0	0		
1	4	656	1182	-1182	655	3	-3	0	0		
1	5	45	82	-82	45	0	0	0	0		
1	6	3	6	-6	3	0	0	0	0		
2	-9	0	2	2	0	0	0	0	0		
2	-8	-2	33	33	2	0	0	0	0		
2	-7	-26	439	439	26	0	0	0	0		
2	-6	-351	5797	5795	350	1	0	0	0		
2	-5	-4597	74763	74721	4594	25	6	0	0		
2	-4	-57416	909399	908653	57356	541	123	0	0		
2	-3	-607441	9156487	9142983	605988	12457	2851	3	1		
2	-2	-1303802	14236840	14061444	1254002	29397	-9322	6	-2		
2	-1	2517684	-40418896	40883491	2611452	824892	-123981	178	-27		
2	0	2779284	-31479769	31470741	2778752	-127690	14246	-28	3		
2	1	146971	-1445040	1444513	146898	-6385	234	-1	0		
2	2	8282	-79603	79578	8279	-211	11	0	0		
2	3	526	-4988	4987	526	-10	0	0	0		
2	4	35	-330	330	35	0	0	0	0		
2	5	2	-23	23	2	0	0	0	0		
2	6	0	-2	2	0	0	0	0	0		
3	-9	-2	2	2	2	0	0	0	0		
3	-8	-27	25	25	27	0	0	0	0		
3	-7	-336	307	307	336	0	0	0	0		
3	-6	-3883	3561	3562	3883	3	7	0	0		
3	-5	-39587	36832	36882	39628	59	116	0	0		
3	-4	-277165	274305	276251	278996	883	1834	0	0		
3	-3	903787	-278004	-193753	-816881	-3736	-3966	-1	-1		
3	-2	3684343	-2470030	2683006	2569180	-131296	-104031	-28	-22		
3	-1	-3525038	998317	-996267	-3537099	-808	-18963	0	-4		
3	0	-1100937	-153944	153850	-1100514	1445	5020	0	1		
3	1	-51451	-7268	7264	-51431	30	180	0	0		
3	2	-2947	-417	417	-2946	1	6	0	0		
3	3	-187	-27	27	-187	0	0	0	0		
3	4	-13	-2	2	-13	0	0	0	0		
4	-9	-6	0	0	6	0	0	0	0		
4	-8	-73	-6	-6	74	0	0	0	0		
4	-7	-780	-69	-69	783	0	3	0	0		
4	-6	-7098	-628	-628	7170	-13	38	0	0		
4	-5	-42917	-3389	-3446	44685	-158	426	0	0		
4	-4	61949	21758	18771	-15500	91	-847	0	0		
4	-3	597306	15384	-144885	695801	-1709	-15943	0	-3		
4	-2	-325030	-228586	176858	-310331	-7912	18042	-2	4		
4	-1	177338	235490	-235799	177493	-45	-684	0	0		
4	0	16724	45329	-45308	16718	179	-155	0	0		
4	1	804	2205	-2204	804	5	-4	0	0		
4	2	47	131	-131	47	0	0	0	0		
4	3	3	8	-8	3	0	0	0	0		

Table A-6. (Cont.)

g) Neptune on Saturn

5	-10	0	-1	-1	0	0	0	0	0
5	-9	-9	-11	-11	9	0	0	0	0
5	-8	-88	-110	-111	89	0	0	0	0
5	-7	-703	-883	-913	730	-11	5	0	0
5	-6	-3511	-4292	-4879	4021	-96	40	0	0
5	-5	6021	11444	-224	3514	177	-133	0	0
5	-4	76112	100171	-105825	75707	1827	-2112	0	0
5	-3	-18444	-60085	79833	-6720	-1651	671	0	0
5	-2	-9055	27246	-20361	-1757	2523	257	1	0
5	-1	18448	-31180	31192	18461	-167	-11	0	0
5	0	4868	-5092	5089	4865	-18	-8	0	0
5	1	254	-264	263	254	0	0	0	0
5	2	16	-16	16	16	0	0	0	0
5	3	1	-1	1	1	0	0	0	0
6	-10	0	-3	-3	0	0	0	0	0
6	-9	4	-28	-29	-4	0	0	0	0
6	-8	28	-199	-217	-29	-3	-1	0	0
6	-7	94	-771	-1073	-125	-22	-10	0	0
6	-6	-811	3058	-1573	196	61	10	0	0
6	-5	-4504	27261	-27749	-5268	575	-28	0	0
6	-4	9504	-13065	13134	10117	-328	-153	0	0
6	-3	-5154	2309	-2525	-3504	86	108	0	0
6	-2	1535	-75	335	1110	33	142	0	0
6	-1	2394	317	-317	2395	-3	-14	0	0
6	0	-101	-106	106	-101	0	0	0	0
6	1	-7	-6	6	-7	0	0	0	0
7	-10	5	-4	-4	-5	0	0	0	0
7	-9	31	-22	-27	-37	0	-1	0	0
7	-8	83	-63	-131	-172	-2	-6	0	0
7	-7	-738	442	-391	-420	10	15	0	0
7	-6	-5349	3619	-3576	-5502	94	89	0	0
7	-5	4086	-473	436	4133	-27	-82	0	0
7	-4	-1201	-390	417	-1217	-4	28	0	0
7	-3	219	198	-173	213	4	-7	0	0
7	-2	-37	-64	63	-38	1	0	0	0
7	-1	-9	-32	32	-9	0	0	0	0
7	0	0	-1	1	0	0	0	0	0
8	-11	0	0	0	-3	0	0	0	0
8	-10	7	1	2	-10	0	0	0	0
8	-9	9	1	8	-49	0	-1	0	0
8	-8	-238	-60	22	-188	-1	5	0	0
8	-7	-1538	-335	363	-1553	0	31	0	0
8	-6	837	708	-719	838	10	-20	0	0
8	-5	-148	-326	330	-147	-6	4	0	0
8	-4	2	78	-80	0	2	0	0	0
8	-3	5	-14	14	5	0	0	0	0
8	-2	-2	3	-3	-2	0	0	0	0
8	12	4	0	0	-4	0	0	0	0
9	-12	-2	-3	3	-2	0	0	0	0
9	-11	-2	-3	6	-4	0	0	0	0
9	-10	-1	-1	11	-7	0	0	0	0
9	-9	-36	-62	49	-35	-1	0	0	0
9	-8	-206	-337	344	-204	-5	5	0	0
9	-7	16	301	-303	15	6	-2	0	0
9	-6	41	-98	98	42	-2	0	0	0
9	-5	-18	17	-17	-18	0	0	0	0
9	-4	4	-2	2	4	0	0	0	0
9	11	0	1	1	0	0	0	0	0
9	12	8	12	12	-8	0	0	0	0
10	-12	3	-13	13	2	0	0	0	0
10	-11	4	-16	18	6	0	0	0	0
10	-10	5	-22	19	4	0	0	0	0
10	-9	26	-98	99	28	-2	0	0	0
10	-8	-58	62	-62	-59	1	0	0	0
10	-7	30	-11	11	30	0	0	0	0
10	-6	-8	0	0	-8	0	0	0	0
10	-5	1	0	0	1	0	0	0	0
10	11	-1	6	6	1	0	0	0	0
10	12	-12	42	42	12	0	0	0	0
11	-12	37	-23	17	37	0	0	0	0
11	-11	22	-23	20	22	0	0	0	0
11	-10	25	-13	12	25	0	0	0	0
11	-9	-24	0	0	-24	0	0	0	0
11	-8	9	5	-5	9	0	0	0	0
11	-7	-2	-2	2	-2	0	0	0	0
11	10	-1	0	0	1	0	0	0	0
11	11	-14	8	8	14	0	0	0	0
11	12	-49	51	51	49	0	0	0	0
12	-12	74	2	-6	71	0	0	0	0
12	-11	18	29	-31	17	0	0	0	0
12	-10	-5	0	0	-5	0	0	0	0
12	-9	0	4	-4	0	0	0	0	0
12	10	-3	0	0	3	0	0	0	0
12	11	-26	-3	-3	26	0	0	0	0
12	12	-28	-76	-76	28	0	0	0	0

Table A-6. (Cont.)
g) Neptune on Saturn

J	K	NDZ ----- (IN UNITS OF 10**(-4)) -----		NU SECONDS OF ARC) -----		D (LONG.) -----		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	-640	0	0	0	-135	0
0	1	0	0	169	6	0	0	36	1
0	2	0	-4	7	0	0	-4	1	0
1	-4	0	0	0	0	-5	5	1	1
1	-3	-6	4	6	8	-68	61	8	9
1	-2	-214	174	157	187	-936	845	104	115
1	-1	-12807	11948	5088	5454	-12874	11975	1072	1153
1	0	-982	310	92	40	-1702	980	-51	-67
1	1	-19	-1	0	-12	-125	64	-8	-15
1	2	0	0	0	0	-9	5	-1	-1
1	3	0	0	0	0	-1	0	0	0
2	-5	0	0	0	-1	5	0	0	-1
2	-4	9	0	1	-15	69	4	1	-10
2	-3	267	12	15	-301	904	54	8	-131
2	-2	10709	680	456	-7183	11239	728	101	-1565
2	-1	9186	834	319	-3653	9780	873	63	-705
2	0	-119	-1	6	-81	438	49	-4	42
2	1	-2	0	0	-1	30	3	0	4
2	2	0	0	0	0	2	0	0	0
3	-5	1	1	2	-2	5	6	1	-1
3	-4	27	31	36	-32	61	68	11	-10
3	-3	614	730	572	-485	599	674	114	-100
3	-2	-313	-1001	-594	166	-274	-977	-131	38
3	-1	73	-299	-108	-13	58	-352	-17	-4
3	0	0	4	-2	0	3	-17	2	0
3	1	0	0	0	0	0	-1	0	0
4	-6	0	1	1	0	0	2	0	0
4	-5	-1	10	11	1	-2	18	3	0
4	-4	-17	148	127	14	-15	144	26	3
4	-3	49	-88	-59	-37	45	-77	-13	-7
4	-2	-68	55	28	38	-66	50	6	8
4	-1	-11	2	1	3	-15	5	0	0
4	0	0	0	0	0	-1	0	0	0
5	-6	-2	2	2	2	-3	3	0	1
5	-5	-23	17	15	20	-22	17	3	4
5	-4	18	-4	-3	-14	16	-3	-1	-3
5	-3	-7	-1	-1	4	-6	-1	0	1
5	-2	9	5	3	-5	9	5	1	-1
5	-1	1	2	0	0	2	2	0	0
6	-7	-1	0	0	1	-1	0	0	0
6	-6	-6	-1	-1	6	-6	-1	0	1
6	-5	3	2	2	-3	3	2	0	-1
6	-4	-1	-1	-1	0	-1	-1	0	0
6	-2	0	1	0	0	0	1	0	0
7	-7	-1	-1	-1	1	-1	-1	0	0
7	-6	0	1	1	0	0	1	0	0

Table A-6. (Cont.)

Secular Terms

g) Neptune on Saturn

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	304694	0	-6797366	0	-116597	0
1	8537	63578	63578	14243	1384922	-304713
2	-100927	2262232	-2258669	-100767	38784	-8536
3	-8490	190009	-189860	-8484	1629	-359
4	-634	14190	-14182	-634	81	-18
5	-46	1035	-1035	-46	4	0
6	-3	75	-75	-3	0	0
7	0	5	-5	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	1884	0	19	0	-432	0
1	-33598	-1508	754	-16798	5128	-1128
2	-471	-21	21	-471	144	-32
3	-13	-1	1	-20	6	-1
4	-1	0	0	-1	0	0
5	0	0	0	1	0	0
6	1	1	0	1	0	0
7	-1	-1	0	1	0	0
8	1	2	0	0	0	0
9	-1	-2	0	0	0	0
10	0	1	-1	0	0	0

Table A-7. Uranus
Periodic Terms
a) Mercury on Uranus

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	-75794	0	4999	0	-1171	0	0	0		
0	1	1077284	-346	591	1076669	0	0	0	0		
0	2	25314	4971	-4966	25305	-6	4	0	0		
0	3	865	353	-353	865	0	0	0	0		
0	4	34	22	-22	34	0	0	0	0		
0	5	1	1	-1	1	0	0	0	0		
1	-3	0	5	5	0	0	0	0	0		
1	-2	-3	62	71	4	0	0	0	0		
1	-1	9	-184	186	11	0	0	0	0		
1	0	-2125	32973	-34237	-1539	3754	6008	0	1		
1	1	10	-185	183	11	0	0	0	0		
1	2	0	-5	5	0	0	0	0	0		
2	-2	0	6	8	0	0	0	0	0		
2	-1	2	-37	37	2	0	0	0	0		
2	0	-56	263	-387	20	381	612	0	0		
2	1	2	-37	37	2	0	0	0	0		
3	-2	0	0	1	0	0	0	0	0		
3	-1	0	-8	8	0	0	0	0	0		
3	0	16	-432	413	30	58	93	0	0		
3	1	0	-8	8	0	0	0	0	0		
4	-1	0	-2	2	0	0	0	0	0		
4	0	7	-163	160	10	11	17	0	0		
4	1	0	-2	2	0	0	0	0	0		
5	0	2	-49	49	3	2	3	0	0		
6	0	0	-14	14	0	0	0	0	0		
7	0	0	-4	4	0	0	0	0	0		
8	0	0	-2	0	0	0	0	0	0		
		NDZ		NU		D (LONG.)		D LOG(R)			
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	0	0	116	0	0	0	24	0		
0	1	0	0	0	1	0	0	0	0		
1	-1	-4	0	0	4	-4	0	0	1		

Table A-7. (Cont.)
 Secular Terms
 a) Mercury on Uranus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-171	0	-141	0	-10	0
1	-4	1	1	-7	147	175
2	57	47	-47	57	3	4
3	4	3	-3	4	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	-2	0	-9	0	-0	0
1	1	0	-4	-4	1	1
2	-4	1	1	-1	0	0
3	2	-3	-2	2	0	0
4	1	2	-2	1	0	0
5	0	0	-1	-2	0	0
6	0	1	0	-1	0	0
7	1	0	-2	0	0	0
8	-1	2	2	-1	0	0
9	0	-2	0	0	0	0
10	1	2	1	-1	0	0
11	-3	-1	1	0	0	0
12	2	-3	1	2	0	0

Table A-7. (Cont.)

Periodic Terms

b) Venus on Uranus

		DX		DY		DZ		U/COS(1)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-1099994	0	2835	0	-456	0	0	0	
0	1	15537835	-197	335	15528955	0	0	0	0	
0	2	358282	2819	-2816	358143	-143	5	0	0	
0	3	12337	197	-197	12333	-8	0	0	0	
0	4	502	12	-12	502	0	0	0	0	
0	5	22	0	0	22	0	0	0	0	
0	6	1	0	0	1	0	0	0	0	
1	-4	7	5	5	-7	0	0	0	0	
1	-3	109	88	90	-112	0	0	0	0	
1	-2	1410	1134	1202	-1494	0	0	0	0	
1	-1	-1596	-1283	1362	-1694	0	0	0	0	
1	0	1120733	901328	-902579	1122533	65253	48262	7	5	
1	1	-1633	-1313	1312	-1631	0	0	0	0	
1	2	-42	-34	34	-42	0	0	0	0	
1	3	-2	-1	1	-2	0	0	0	0	
2	-3	0	3	3	0	0	0	0	0	
2	-2	5	4	4	-5	0	0	0	0	
2	-1	-11	-8	9	-11	0	0	0	0	
2	0	2958	2379	-2384	2965	223	165	0	0	
2	1	-11	-9	9	-11	0	0	0	0	
3	0	11	9	-9	11	1	0	0	0	
		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	1672	0	0	0	352	0	
0	1	0	0	-1	1	0	0	0	0	
1	-3	0	0	0	0	0	1	0	0	
1	-2	-2	3	5	4	-7	8	2	1	
1	-1	-97	120	121	97	-97	120	25	20	
1	0	7	-9	0	0	2	-3	-1	-1	

Table A-7. (Cont.)

Secular Terms

b) Venus on Uranus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	31	0	-7202	0	-13	0
1	0	56	56	1	191	4709
2	-10	2398	-2395	-10	4	110
3	0	169	-168	0	0	4
4	0	11	-11	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	3	0	-9	0	-0	0
1	-53	-2	-2	-25	1	25
2	-2	1	2	-2	0	1
3	4	-1	-1	0	0	0
4	-4	0	0	1	0	0
5	1	1	-2	-1	0	0
6	2	-2	0	-2	0	0
7	-2	3	1	0	0	0
8	2	-1	0	0	0	0
9	-2	0	0	-1	0	0
10	0	-1	2	1	0	0
11	2	1	1	1	0	0
12	1	-1	0	1	0	0

Table A-7. (Cont.)
 Periodic Terms
 c) Earth on Uranus

		DX				DY		DZ		J/COS(I)	
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	-1367687	0	17661	0	323	0	0	0		
0	1	19298711	-1226	2086	19287622	0	0	0	0		
0	2	443559	17565	-17545	443387	100	-6	0	0		
0	3	15174	1214	-1214	15169	6	0	0	0		
0	4	613	75	-75	613	0	0	0	0		
0	5	27	4	-4	27	0	0	0	0		
0	6	1	0	0	1	0	0	0	0		
1	-4	6	14	14	-6	0	0	0	0		
1	-3	96	229	234	-98	0	0	0	0		
1	-2	1201	2959	3076	-1249	0	0	0	0		
1	-1	-845	-2080	2282	-926	0	0	0	0		
1	0	1010736	2489360	-2489846	1010812	-18707	-36515	-2	-4		
1	1	-874	-2152	2152	-874	0	0	0	0		
1	2	-23	-57	57	-23	0	0	0	0		
1	3	0	-2	2	0	0	0	0	0		
2	-4	-2	2	2	2	0	0	0	0		
2	-3	-9	11	11	9	0	0	0	0		
2	-2	10	24	25	-11	0	0	0	0		
2	-1	-15	-32	34	-15	0	0	0	0		
2	0	7380	18177	-18181	7381	-157	-306	0	0		
2	1	-14	-34	34	-14	0	0	0	0		
3	0	79	195	-195	79	-2	-4	0	0		
4	0	0	2	-2	0	0	0	0	0		
		NDZ		NU		D (LONG.)		D LOG(R)			
		(IN UNITS OF 10**(-4) SECONDS OF ARC)									
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	0	0	2077	0	0	0	437	0		
0	1	0	0	-2	4	0	0	0	1		
1	-3	0	0	0	1	-1	0	0	0		
1	-2	-6	2	5	12	-19	8	2	4		
1	-1	-267	109	109	268	-267	108	23	56		
1	0	19	-8	0	0	7	-3	-1	-1		
2	-1	-2	1	1	2	-2	1	0	0		

Table A-7. (Cont.)

Secular Terms

c) Earth on Uranus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	372	0	-17117	0	21	0
1	9	134	134	15	-291	-3292
2	-124	5699	-5693	-123	-7	-77
3	-9	401	-400	-9	0	-3
4	0	25	-25	0	0	0
5	0	2	-2	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	5	0	-10	0	0	0
1	-120	-3	0	-58	-2	-17
2	-3	1	3	-2	0	0
3	2	-2	-1	1	0	0
4	-2	2	-2	0	0	0
5	0	-1	-1	-1	0	0
6	3	1	-2	-1	0	0
7	-2	0	0	1	0	0
8	2	3	1	1	0	0
9	-1	-2	0	-1	0	0
10	-1	1	4	0	0	0
11	1	0	0	2	0	0
12	-1	-1	0	2	0	0

Table A-7. (Cont.)
Periodic Terms
d) Mars on Uranus

		DX		DY		DZ		U/COS(1)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-126616	0	-4415	0	1296	0	0	0	
0	1	2035967	275	-553	2033763	0	0	0	0	
0	2	64412	-4387	4377	64364	-33	36	0	0	
0	3	2953	-382	382	2951	-2	2	0	0	
0	4	159	-30	30	159	0	0	0	0	
0	5	9	-2	2	9	0	0	0	0	
1	-4	-6	-2	-2	6	0	0	0	0	
1	-3	-52	-17	-17	53	0	0	0	0	
1	-2	-518	-138	-141	530	0	0	0	0	
1	-1	198	53	-62	235	0	0	0	0	
1	0	-440169	-117380	117562	-439108	-8728	5162	-1	1	
1	1	211	57	-57	211	0	0	0	0	
1	2	5	2	-2	5	0	0	0	0	
2	-4	2	2	2	-2	0	0	0	0	
2	-3	7	5	5	-7	0	0	0	0	
2	-2	-23	-6	-7	24	0	0	0	0	
2	-1	18	5	-6	20	0	0	0	0	
2	0	-19150	-5110	5114	-19116	-406	240	0	0	
2	1	18	5	-5	18	0	0	0	0	
3	-2	-2	0	0	2	0	0	0	0	
3	-1	2	0	0	2	0	0	0	0	
3	0	-1244	-332	332	-1242	-28	17	0	0	
3	1	2	0	0	2	0	0	0	0	
4	0	-95	-25	25	-95	-2	1	0	0	
5	0	-8	-2	2	-8	0	0	0	0	
		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	219	0	0	0	46	0	
0	1	0	0	4	-1	0	0	1	0	
1	-2	0	-1	-2	-1	1	-3	-1	0	
1	-1	13	-47	-47	-13	13	-47	-10	-3	
1	0	-1	3	0	0	0	1	0	0	
2	-1	1	-2	-2	-1	1	-2	0	0	

Table A-7. (Cont.)

Secular Terms

d) Mars on Uranus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-217	0	-5126	0	-64	0
1	-5	40	40	-8	905	922
2	72	1707	-1705	72	21	22
3	5	120	-120	5	0	0
4	0	7	-7	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	2	0	-10	0	-0	0
1	-36	3	-3	-16	5	5
2	-3	0	1	-2	0	0
3	2	-2	-1	2	0	0
4	-2	1	-1	0	0	0
5	0	3	-1	-2	0	0
6	2	-2	-1	-2	0	0
7	-3	2	1	1	0	0
8	2	0	-2	0	0	0
9	0	-1	-1	-1	0	0
10	-2	0	1	-1	0	0
11	0	2	2	0	0	0
12	1	-2	0	0	0	0

Table A-7. (Cont.)
Periodic Terms
e) Jupiter on Uranus

		DX		DY		DZ		U/COS(I)	
		(IN UNITS OF 10**(-12))							
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
U	0	-330504964	0	41315369	0	6308310	0	678	0
U	1	6406835133	-1681295	6062037	6390367255	0	0	0	0
U	2	270224800	41054281	-40881702	269839196	-764973	-1123517	-82	-121
U	3	13560597	3896992	-3887129	13544851	-48650	-84011	-5	-9
U	4	786583	346575	-345934	785789	-2897	-6097	0	-1
U	5	49908	30375	-30330	49863	-168	-453	0	0
U	6	3335	2636	-2632	3333	-9	-34	0	0
U	7	229	227	-226	229	0	-3	0	0
U	8	16	19	-19	16	0	0	0	0
U	9	1	1	-2	1	0	0	0	0
1	-10	8198	-18057	-18049	-8195	0	0	0	0
1	-9	156284	-343689	-343538	-156221	2	5	0	0
1	-8	3384530	-7394893	-7390454	-3382554	150	333	0	0
1	-7	-3471773	6215381	6131713	3440089	342	6167	0	1
1	-6	-4070096	8196276	-5412054	-2192829	-2369	-68169	0	-7
1	-5	-1522028	1533131	4652546	3332645	1175	-24936	0	-3
1	-4	-7436479	8077515	8686012	7819308	8908	-58924	1	-6
1	-3	-19875153	18243767	18621019	20161349	44965	-170213	5	-18
1	-2	-20032925	8317256	8407501	20136674	159756	-379589	17	-41
1	-1	-2188094	857600	-515303	1564471	188985	-20833	20	-2
1	0	-4491502540	1965047356	-1965860537	-4488773115	-54563018	-26099991	-5867	-2806
1	1	-318741	-220758	219594	-308195	36763	28243	4	3
1	2	-96793	-10213	10069	-96082	3723	3474	0	0
1	3	-11055	-1674	1660	-11007	323	354	0	0
1	4	-1078	-265	264	-1074	26	33	0	0
1	5	-98	-35	35	-98	2	3	0	0
1	6	-9	-4	4	-9	0	0	0	0
1	8	1	-3	-3	-2	0	0	0	0
1	9	26	-56	-56	-26	0	0	0	0
1	10	449	-972	-972	-448	0	0	0	0
2	-10	17	-348	-328	-20	-1	-1	0	0
2	-9	293	-1996	-1752	-308	3	4	0	0
2	-8	2851	-10682	-10673	-2853	14	23	0	0
2	-7	22655	-59835	-59829	-22657	61	126	0	0
2	-6	158175	-318152	-317864	-158121	231	649	0	0
2	-5	955042	-1526450	-1523413	-954059	680	2977	0	0
2	-4	4627757	-6031140	-6006409	-4616560	881	11104	0	1
2	-3	14225392	-15376400	-15203275	-14123099	-5240	26649	-1	3
2	-2	-246166	113422	1137259	1010113	-42865	6496	-5	1
2	-1	2037658	-2194260	2188188	2042445	-166235	-5497	-18	-1
2	0	-107078850	46605544	-46816083	-107038176	-1330227	-632822	-143	-68
2	1	29091	-17109	17090	29082	-643	-70	0	0
2	2	1066	-840	839	1065	-46	-6	0	0
2	3	48	-53	53	48	-3	0	0	0
2	4	2	-4	4	2	0	0	0	0
2	9	1	13	13	-1	0	0	0	0
2	10	20	310	309	-20	0	0	0	0
3	-10	100	377	327	-77	3	2	0	0
3	-9	409	2434	1951	-229	-4	-3	0	0
3	-8	609	12985	12933	-591	-18	-16	0	0
3	-7	-3503	69531	69390	3529	-77	-87	0	0
3	-6	-47030	321845	320833	47106	-272	-410	0	0
3	-5	-281151	1165758	1159035	280968	-635	-1524	0	0
3	-4	-837912	2525016	2485527	832804	54	-3794	0	0
3	-3	281433	-334366	-523774	-325401	7607	-4205	1	0
3	-2	-113368	309762	-278328	-82673	23434	-9517	3	-1
3	-1	36688	-34740	34720	36901	-2200	-362	0	0
3	0	-3837188	1678808	-1679011	-3836095	-47863	-22886	-5	-2
3	1	1164	-552	552	1164	-5	-2	0	0
3	2	39	-21	21	39	0	0	0	0
3	3	2	-1	1	2	0	0	0	0
3	8	0	-1	-1	0	0	0	0	0
3	9	-11	-27	-27	11	0	0	0	0
3	10	-250	-669	-668	249	0	0	0	0
4	-10	-406	-623	-498	291	-6	-1	0	0
4	-9	-1990	-3724	-2621	1132	5	2	0	0
4	-8	-6204	-16314	-16199	6119	24	12	0	0
4	-7	-19411	-70091	-69830	19274	83	62	0	0
4	-6	-41946	-227967	-226410	41324	200	245	0	0
4	-5	-44761	-416876	-408750	42403	117	715	0	0
4	-4	-30707	113244	146413	24399	-1204	1489	0	0
4	-3	3939	-54197	26685	-12413	-3029	3177	0	0
4	-2	-4124	11112	-10199	-3156	805	-312	0	0
4	-1	941	-903	904	981	-6	-6	0	0
4	0	-162893	71279	-71284	-162856	-2050	-980	0	0
4	1	57	-26	26	57	0	0	0	0
4	2	2	0	0	2	0	0	0	0
4	8	2	2	2	-2	0	0	0	0
4	9	51	63	63	-50	0	0	0	0
4	10	1215	1561	1558	-1212	0	0	0	0

Table A-7. (Cont.)
e) Jupiter on Uranus

5	-10	1029	809	590	-642	9	0	0	0
5	-9	4624	4259	2461	-1987	-7	0	0	0
5	-8	11271	13676	13498	-11022	-23	-7	0	0
5	-7	27712	40201	39890	-27394	-57	-40	0	0
5	-6	37424	62222	60774	-36211	-61	-153	0	0
5	-5	-4875	-24713	-34909	8488	121	-422	0	0
5	-4	2304	11010	690	3843	264	-768	0	0
5	-3	-21	-2930	1944	-541	-176	190	0	0
5	-2	-146	411	-377	-109	30	-12	0	0
5	-1	30	-28	29	31	-2	0	0	0
5	0	-7545	3324	-3324	-7594	-97	-46	0	0
5	1	3	-1	1	3	0	0	0	0
5	8	-4	-4	-4	4	0	0	0	0
5	9	-156	-102	-102	155	0	0	0	0
5	10	-3771	-2570	-2564	3760	1	0	0	0
6	-10	-1737	-593	-413	838	-11	2	0	0
6	-9	-6620	-2747	-1203	1266	6	0	0	0
6	-8	-9377	-5597	-5449	8898	16	6	0	0
6	-7	-10976	-7274	-7077	10563	24	32	0	0
6	-6	4204	6279	6918	-5272	13	101	0	0
6	-5	-1329	-2409	-1349	-245	17	154	0	0
6	-4	259	715	-190	298	22	-68	0	0
6	-3	-8	-140	101	-26	-9	10	0	0
6	-2	-6	16	-15	-4	1	0	0	0
6	-1	1	-1	1	1	0	0	0	0
6	0	-376	165	-165	-376	-5	-2	0	0
6	7	-2	0	0	2	0	0	0	0
6	8	3	5	3	-4	0	0	0	0
6	9	323	86	86	-320	0	0	0	0
6	10	7696	2217	2213	-7666	-2	0	0	0
7	-10	1907	-42	135	-500	10	-3	0	0
7	-9	5868	121	432	1100	-4	0	0	0
7	-8	2648	300	320	-2059	-8	-6	0	0
7	-7	-1579	-980	-1008	1858	-13	-21	0	0
7	-6	545	489	445	-236	-16	-25	0	0
7	-5	-131	-164	-37	-60	2	14	0	0
7	-4	19	40	-16	20	1	-4	0	0
7	-3	0	-7	5	0	0	0	0	0
7	0	-19	8	-8	-19	0	0	0	0
7	6	1	0	0	-1	0	0	0	0
7	7	5	-2	-2	-5	0	0	0	0
7	8	2	-4	-5	-3	0	0	0	0
7	9	-435	29	27	427	0	0	0	0
7	10	-10054	455	444	9998	2	-2	0	0
8	-10	-1277	552	-160	-116	-7	1	0	0
8	-9	-3075	1222	-926	-2258	2	0	0	0
8	-8	271	126	-35	-690	5	3	0	0
8	-7	-199	-68	-93	126	5	3	0	0
8	-6	50	33	23	-5	-3	-4	0	0
8	-5	-11	-9	-2	-7	0	1	0	0
8	-4	0	3	-2	0	0	0	0	0
8	0	-1	0	0	-1	0	0	0	0
8	6	-2	2	2	0	0	0	0	0
8	7	-8	6	7	9	0	0	0	0
8	8	-15	12	14	17	0	0	0	0
8	9	355	-159	-150	-343	0	0	0	0
8	10	7722	-3109	-3068	-7653	-2	2	0	0
9	-10	481	-427	269	339	5	0	0	0
9	-9	841	-847	931	1063	-1	0	0	0
9	-8	122	-61	71	21	-1	0	0	0
9	-7	-11	-12	4	16	1	0	0	0
9	-6	7	-3	7	4	0	0	0	0
9	-5	0	-3	2	1	0	0	0	0
9	6	2	-4	-4	-2	0	0	0	0
9	7	8	-12	-13	-9	0	0	0	0
9	8	19	-26	-30	-21	0	0	0	0
9	9	-156	129	112	144	0	0	0	0
9	10	-2772	2619	2559	2721	2	0	0	0
10	-10	28	398	-464	-13	-2	0	0	0
10	-9	-34	151	-161	-8	0	0	0	0
10	-8	3	27	-36	-7	0	0	0	0
10	-7	-3	15	-18	-2	0	0	0	0
10	-6	0	7	-7	-1	0	0	0	0
10	-5	0	2	-2	0	0	0	0	0
10	5	0	1	1	0	0	0	0	0
10	6	0	5	5	0	0	0	0	0
10	7	-4	13	15	4	0	0	0	0
10	8	-11	19	25	12	0	0	0	0
10	9	-14	-129	-110	18	0	0	0	0
10	10	66	-437	-388	-47	0	0	0	0

Table A-7. (Cont.)
e) Jupiter on Uranus

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	689432	0	0	0	145161	0
0	1	-11	51	25904	8877	0	0	5449	1868
0	2	230	-1015	2196	865	230	-1015	462	182
0	3	9	-43	140	67	20	-90	34	15
0	4	0	-2	9	5	1	-7	2	1
0	5	0	0	1	0	0	-1	0	0
1	-9	0	0	0	0	-4	-2	0	1
1	-8	-2	-1	0	1	-74	-33	-3	8
1	-7	-1569	-724	33	-73	-1529	-702	9	-20
1	-6	854	477	-256	457	789	449	-50	88
1	-5	162	104	-100	146	210	129	-23	33
1	-4	284	204	-317	349	279	117	-80	78
1	-3	598	281	-2022	1438	-109	-1460	-639	392
1	-2	-3085	-9326	-24860	12007	-12877	-31748	-7595	3564
1	-1	-210322	-480461	-485083	212336	-209765	-479294	-101920	44619
1	0	14949	34210	-341	42	5074	11655	2303	-1030
1	1	-101	12	-39	-100	21	295	-10	-20
1	2	-2	2	-5	-4	-1	16	-2	-1
1	3	0	0	0	0	0	1	0	0
2	-7	-1	0	0	-1	-1	0	0	0
2	-6	-4	-1	3	-7	-5	-2	0	-1
2	-5	-21	-9	18	-36	-28	-14	3	-7
2	-4	-109	-62	109	-177	-138	-86	20	-34
2	-3	-483	-359	522	-706	-578	-471	98	-140
2	-2	-1599	-1639	1205	-1650	-1856	-2192	199	-325
2	-1	-5017	-11489	-11505	5020	-5075	-11527	-2410	1048
2	0	356	814	4	-3	116	271	58	-26
2	1	-2	-1	1	-2	1	5	0	0
3	-7	1	0	0	1	1	0	0	0
3	-6	5	0	0	8	6	0	0	2
3	-5	24	3	-5	38	29	4	-1	7
3	-4	96	21	-33	138	108	25	-7	28
3	-3	244	82	-103	308	247	80	-22	66
3	-2	-40	-38	12	-27	-37	-53	0	-4
3	-1	-180	-412	-413	181	-180	-412	-87	38
3	0	13	29	0	0	4	10	2	-1
4	-7	-1	0	-1	-2	-1	1	0	0
4	-6	-5	2	-2	-8	-6	2	0	-2
4	-5	-20	4	-5	-27	-22	4	-1	-5
4	-4	-42	4	-5	-50	-42	4	-1	-11
4	-3	12	3	-4	13	9	3	-1	3
4	-2	-1	-1	0	-1	-1	-2	0	0
4	-1	-8	-17	-18	8	-8	-17	-4	2
4	0	1	1	0	0	0	0	0	0
5	-7	1	-1	1	2	1	-1	0	0
5	-6	4	-3	3	5	4	-3	1	1
5	-5	6	-4	4	7	6	-4	1	2
5	-4	-3	1	-1	-3	-3	0	0	-1
5	-3	0	0	0	1	0	0	0	0
5	-1	0	-1	-1	0	0	-1	0	0
6	-7	-1	1	-1	-1	-1	1	0	0
6	-6	-1	1	-1	-1	-1	1	0	0
6	-5	1	0	0	1	1	0	0	0
6	11	0	-1	1	0	0	-1	0	0
7	11	0	1	-1	0	0	1	0	0
8	11	0	-1	1	0	0	-1	0	0

Table A-7. (Cont.)
 Secular Terms
 e) Jupiter on Uranus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	23468109	0	-223702749	0	1575178	0
1	550224	1752042	1748158	917691	-22369489	19616925
2	-7788305	74485705	-74403631	-7779692	-524289	459860
3	-548124	5236357	-5233471	-547821	-18433	16169
4	-34271	327275	-327155	-34258	-768	674
5	-2092	19976	-19971	-2092	-35	31
6	-127	1214	-1213	-127	-2	1
7	-8	74	-74	-8	0	0
8	0	4	-4	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	73550	0	1920	0	8272	0
1	-1567662	-164553	82274	-783829	-117474	103018
2	-18377	-1927	1930	-18377	-2753	2415
3	-429	-45	68	-645	-97	85
4	-15	-2	1	-27	-4	4
5	3	0	0	0	0	0
6	-1	0	-2	-2	0	0
7	1	0	0	-2	0	0
8	-1	3	1	-1	0	0
9	1	0	1	1	0	0
10	-1	-2	-1	0	0	0
11	1	2	1	0	0	0
12	0	-3	-2	-1	0	0

Table A-7. (Cont.)
Periodic Terms
f) Saturn on Uranus

		DX		DY		DZ		U/COS(1)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	-139690943	0	95825083	0	19068058	0	2050	0		
0	1	2249899371	-3327194	14994864	2249657914	0	0	0	0		
0	2	73732261	94852316	-94728795	73939390	377715	-5768992	41	-620		
0	3	-274621	4694639	-4698054	-265555	189416	-331298	20	-36		
0	4	-218639	106799	-107207	-218464	19648	-11932	2	-1		
0	5	-17508	-7834	7812	-17515	1340	18	0	0		
0	6	-763	-1237	1236	-764	61	45	0	0		
0	7	-4	-91	91	-4	1	4	0	0		
0	8	2	-3	3	2	0	0	0	0		
1	-11	-8	5	5	8	0	0	0	0		
1	-10	-135	88	88	135	0	0	0	0		
1	-9	-2285	1484	1483	2285	0	0	0	0		
1	-8	-39065	25164	25159	39058	16	9	0	0		
1	-7	-676381	435310	435212	676229	185	380	0	0		
1	-6	-11989114	7779749	7777640	11985728	194	9487	0	1		
1	-5	-221790694	146490239	146439332	221707554	-65731	212010	-7	23		
1	-4	-4454975781	3047781847	3046244192	4452487821	-3185100	5617817	-342	604		
1	-3	-9306726115	1194569296	1130911220	9264981567	2091282	-12057490	225	-1297		
1	-2	5298834286	-2943458061	4433809803	4888244876	235901677	142517701	25366	15325		
1	-1	3771560083	-586696299	592387543	3812899222	2561465	-8360456	275	-899		
1	0	791728337	2527876823	-2530688408	790486079	-48285871	64977717	-5192	6987		
1	1	9719457	-10585341	10551967	9723706	1075436	-145038	116	-16		
1	2	530150	-959727	958880	529145	73618	32720	8	4		
1	3	45118	-70803	70830	45054	3158	4250	0	0		
1	4	3934	-3984	3987	3930	38	313	0	0		
1	5	270	-147	147	269	-7	15	0	0		
1	6	10	0	0	10	0	0	0	0		
2	-12	-14	-4	-4	14	0	0	0	0		
2	-11	-234	-77	-77	234	0	0	0	0		
2	-10	-4002	-1371	-1371	4001	3	4	0	0		
2	-9	-69760	-24318	-24312	69740	18	109	0	0		
2	-8	-1262129	-434934	-434779	1261667	-494	2167	0	0		
2	-7	-24256350	-8081867	-8077808	24243133	-24972	43935	-3	5		
2	-6	-140712975	-138923852	-139014002	140235452	132006	-274877	14	-30		
2	-5	48047244	171992019	161807194	11032209	4324984	4434128	465	477		
2	-4	-55340099	258278162	130799619	182536259	-1736479	-7067954	-187	-760		
2	-3	-346850988	122314478	171785879	347992567	2393506	-6828839	253	-734		
2	-2	15116253	-20246088	8769515	-7019	2169883	-829575	233	-89		
2	-1	-5069389	864536	-817137	-5037841	5157917	2365427	555	254		
2	0	16360884	72534522	-72574112	16307480	-1369525	2333886	-147	251		
2	1	104702	-85746	86067	104886	4465	18404	0	2		
2	2	8250	-3332	3347	8264	-139	1019	0	0		
2	3	430	-32	35	428	-20	43	0	0		
2	4	0	0	1	0	0	2	0	0		
2	5	-4	-3	4	-4	0	0	0	0		
2	6	0	-1	1	0	0	0	0	0		
3	-12	-646	-385	-386	647	0	3	0	0		
3	-11	-11472	-6882	-6889	11471	-5	26	0	0		
3	-10	-213549	-128967	-128916	213434	-236	426	0	0		
3	-9	-2216872	-2584079	-2583954	2211573	4532	-4514	0	0		
3	-8	324513	4618512	4480009	179647	57924	93276	6	10		
3	-7	-2640816	6319220	3521273	4941323	-21827	-284806	-2	-31		
3	-6	-15427091	3524230	5174719	15906510	191825	-357140	21	-38		
3	-5	-39813235	-15102249	-14078846	40464342	733288	-377460	79	-41		
3	-4	-45368995	-64306099	-63962426	46391694	1316844	186737	142	20		
3	-3	-2261609	4404726	4597170	1553033	362738	607682	39	65		
3	-2	-2206817	-3404649	3227619	-2389000	-365176	1657590	-39	178		
3	-1	-249976	152825	-150532	-246337	25539	84215	3	9		
3	0	639242	3091736	-3093120	637260	-66003	92177	-7	10		
3	1	-1069	363	-346	-1062	-54	238	0	0		
3	2	-136	-6	12	-133	-2	15	0	0		
3	3	-12	-20	21	-11	0	1	0	0		
3	4	2	-6	6	2	0	0	0	0		
3	5	1	-1	0	1	0	0	0	0		
3	11	-2	-2	-2	2	0	0	0	0		
3	12	-43	-36	-36	43	0	0	0	0		
4	-12	-43684	-59498	-59503	43531	71	-93	0	0		
4	-11	-5775	124957	122926	11076	670	1875	0	0		
4	-10	-69614	140516	64067	122246	651	-8961	0	-1		
4	-9	-386687	38294	90632	392684	1719	-9650	1	-1		
4	-8	-1188343	-630494	-604046	1207956	29775	-10019	3	-1		
4	-7	-2031355	-4047179	-4037769	2089591	85609	24913	9	3		
4	-6	1817797	-12604789	-12623544	-1782311	138998	172233	15	19		
4	-5	14662177	-16469410	-16391559	-14716544	19170	376091	2	40		
4	-4	-2277104	-1171378	-318590	2356404	-195868	174661	-21	19		
4	-3	874743	-887965	1104448	907010	-573528	272	-62	0		
4	-2	-102687	-127553	121995	-106477	-21782	40324	-2	4		
4	-1	-14895	188	-109	-14764	330	1714	0	0		
4	0	31166	152566	-152617	31092	-3271	4480	0	0		
4	1	-33	-110	108	-24	-3	8	0	0		
4	2	18	-14	12	20	0	0	0	0		
4	3	7	0	-1	7	0	0	0	0		
4	4	1	1	-1	1	0	0	0	0		
4	10	-7	-8	-8	7	0	0	0	0		
4	11	-127	-140	-140	127	0	0	0	0		
4	12	-2248	-2537	-2536	2247	-2	7	0	0		

Table A-7. (Cont.)
f) Saturn on Uranus

5	-12	-8528	795	414	8429	-169	118	0	0
5	-11	-28176	-15425	-19218	24240	811	-146	0	0
5	-10	-42349	-117968	-118135	43061	2592	1175	0	0
5	-9	136474	-466324	-469200	-134974	4963	8400	1	1
5	-8	1316498	-1048163	-1049122	-1316205	-2351	30251	0	3
5	-7	4524641	-324554	-312691	-4523536	-48531	58887	-5	6
5	-6	6238243	3381490	3442507	-6172022	-124279	30730	-13	3
5	-5	370704	-1172653	-1130357	12450	-84759	-63540	-9	-7
5	-4	301338	207310	-208347	465950	-46019	-202526	-5	-22
5	-3	43559	-59237	65753	43435	-25696	-691	-3	0
5	-2	-2852	-7560	7320	-2876	-773	1356	0	0
5	-1	-237	-286	255	-214	0	56	0	0
5	0	1814	8344	-8357	1808	-180	242	0	0
5	1	18	22	-24	17	0	0	0	0
5	2	0	9	-9	0	0	0	0	0
5	3	-1	2	-2	-1	0	0	0	0
5	10	8	-11	-11	-8	0	0	0	0
5	11	163	-205	-205	-163	0	0	0	0
5	12	4433	-4415	-4411	-4432	7	22	0	0
6	-12	4290	-14240	-11250	-5384	-139	-514	0	0
6	-11	44052	-34561	-20751	-48097	-243	1048	0	0
6	-10	209807	16700	17660	-210094	-2890	2636	0	0
6	-9	541958	446245	447205	-540683	-12035	1534	-1	0
6	-8	503112	1690612	1691312	-493271	-26177	-13863	-3	-1
6	-7	-636186	2388933	2361076	673216	-20311	-43751	-2	-5
6	-6	575209	59463	-92866	-524858	18936	-40531	2	-4
6	-5	-46897	89422	-195610	-27797	70673	-34342	8	-4
6	-4	29353	12010	-11125	35623	-4260	-13080	0	-1
6	-3	3418	-2508	2586	3340	-1175	-14	0	0
6	-2	101	-28	-15	61	-32	47	0	0
6	-1	-26	120	-123	-39	0	1	0	0
6	0	74	515	-514	71	-10	14	0	0
6	1	-11	4	-3	-12	0	0	0	0
6	2	-3	0	0	-3	0	0	0	0
6	3	0	2	2	0	0	0	0	0
6	4	0	37	37	-16	0	0	0	0
6	10	331	721	721	-330	-1	0	0	0
6	12	5395	18079	18067	-5380	-66	-16	0	0
7	-12	20770	18094	20308	-15190	1376	153	0	0
7	-11	35279	101752	93782	11301	-1376	-1020	0	0
7	-10	-140729	276691	275206	144878	-1704	-4975	0	-1
7	-9	-628946	352201	346882	630916	3458	-11824	0	-1
7	-8	-905628	-15628	-34548	895823	15691	-11414	2	-1
7	-7	29772	268183	234048	-88029	18914	4327	2	0
7	-6	-21043	-12289	-12386	-82134	19432	23655	2	3
7	-5	-2053	13569	-18509	-597	5827	-4040	1	0
7	-4	1510	1806	-1720	1536	-286	-734	0	0
7	-3	-203	188	-144	-263	-51	0	0	0
7	-2	-180	11	5	-187	0	3	0	0
7	-1	-52	-24	28	-51	0	0	0	0
7	0	-2	16	-15	-1	0	0	0	0
7	1	0	-4	4	0	0	0	0	0
7	2	-8	-4	-4	9	0	0	0	0
7	3	-137	-14	-14	138	0	0	0	0
7	10	-2783	-32	-37	2782	4	-3	0	0
7	12	-63718	-10698	-10746	63643	148	-161	0	0
8	-12	-46790	27109	6266	45957	-1357	2555	0	0
8	-11	-175321	18566	-91720	100063	2018	-1131	0	0
8	-10	-206068	-221035	-230588	198567	5349	437	1	0
8	-9	-78719	-334097	-331062	70102	6003	5523	1	1
8	-8	-118636	39863	62559	98055	-58	8548	0	1
8	-7	5417	-1917	33773	-16964	-7267	9756	-1	1
8	-6	-6648	767	-2237	-10232	2743	2288	0	0
8	-5	-1605	831	-732	-1551	378	-312	0	0
8	-4	-452	-356	447	-412	-17	-35	0	0
8	-3	-80	-241	255	-63	-3	1	0	0
8	-2	16	-75	75	21	0	0	0	0
8	-1	14	-14	13	15	0	0	0	0
8	0	5	0	-1	5	0	0	0	0
8	1	4	-2	-2	-4	0	0	0	0
8	2	31	-15	-15	-31	0	0	0	0
8	10	231	-328	-329	-235	0	0	0	0
8	11	3372	-7603	-7589	-3399	2	12	0	0

Table A-7. (Cont.)
f) Saturn on Uranus

b	12	104410	-153679	-153327	-104493	211	571	0	0
y	-12	-24586	-81626	-57873	-25331	-2808	-3530	0	0
y	-11	-3349	-227191	15691	-151652	220	2311	0	0
y	-10	113553	-64564	-49903	-121885	-1809	3027	0	0
y	-9	-28704	-50236	-35379	38327	-3698	824	0	0
y	-8	-2399	3465	14484	12335	-4527	-1847	0	0
y	-7	-2114	-4282	7038	-3239	-750	1616	0	0
y	-6	-753	-2170	2229	-498	238	166	0	0
y	-5	402	-863	840	531	16	-20	0	0
y	-4	301	-191	172	324	-3	-3	0	0
y	-3	102	0	-5	104	0	0	0	0
y	-2	21	14	-15	21	0	0	0	0
y	-1	2	5	-5	2	0	0	0	0
y	0	0	1	-1	0	0	0	0	0
y	7	1	3	3	-1	0	0	0	0
y	8	-2	22	22	2	0	0	0	0
y	9	-37	115	118	35	0	0	0	0
y	10	315	819	841	-312	0	-3	0	0
y	11	13237	13652	13746	-13135	-21	-8	0	0
y	12	217947	342887	342778	-216768	-1294	-101	0	0
10	-12	100296	-17705	55648	-9726	4953	-1530	1	0
10	-11	246285	67	80319	179248	-1325	-513	0	0
10	-10	35313	-17632	-17935	7588	-733	-1487	0	0
10	-9	-1429	-3760	-1211	12933	228	-1947	0	0
10	-8	3977	-4146	4900	6611	-882	-153	0	0
10	-7	3201	-1427	1021	3473	-65	152	0	0
10	-6	1439	296	-470	1450	15	2	0	0
10	-5	358	350	-383	341	1	-4	0	0
10	-4	31	134	-137	24	0	0	0	0
10	-3	-12	30	-30	-13	0	0	0	0
10	-2	-6	4	-4	-6	0	0	0	0
10	-1	-1	0	0	-1	0	0	0	0
10	6	-2	1	1	2	0	0	0	0
10	7	-15	0	0	15	0	0	0	0
10	8	-70	-47	-46	72	0	0	0	0
10	9	-224	-318	-317	241	2	0	0	0
10	10	-1439	-565	-614	1519	6	5	0	0
10	11	-30242	12801	12347	30416	29	-14	0	0
10	12	-606316	119301	116548	605029	1110	-1661	0	0
11	-12	32689	98106	-58381	65532	-164	3083	0	0
11	-11	-20743	199095	-195656	-31669	491	-374	0	0
11	-10	3801	11119	-23719	5223	737	-153	0	0
11	-9	7865	4873	-8079	8539	-49	-471	0	0
11	-8	3116	4577	-5177	2604	-87	-30	0	0
11	-7	54	2217	-2284	-166	6	5	0	0
11	-6	-367	600	-587	-414	5	0	0	0
11	-5	-166	79	-71	-172	0	0	0	0
11	-4	-41	-6	8	-41	0	0	0	0
11	-3	-6	-6	6	-6	0	0	0	0
11	-2	0	-2	2	0	0	0	0	0
11	5	-1	-1	-1	1	0	0	0	0
11	6	-1	-11	-11	2	0	0	0	0
11	7	25	-50	-51	-23	0	0	0	0
11	8	220	-131	-142	-217	0	1	0	0
11	9	957	-60	-119	-978	-3	4	0	0
11	10	1616	-519	-697	-1863	-13	6	0	0
11	11	-12023	-36628	-36618	10736	3	33	0	0
11	12	70899	-546363	-542363	-75492	1579	2251	0	0
12	-12	14884	-1438	-10406	12431	-1041	-314	0	0
12	-11	-62238	-16785	9239	-74711	150	164	0	0
12	-10	-7994	12907	-14101	-12391	265	-115	0	0
12	-9	-6243	6230	-5700	-7302	31	-49	0	0
12	-8	-3224	807	-543	-3375	5	10	0	0
12	-7	-934	-317	380	-929	2	5	0	0
12	-6	-150	-193	202	-142	0	1	0	0
12	-5	-3	-53	53	-2	0	0	0	0
12	-4	5	-9	9	6	0	0	0	0
12	-3	2	0	0	2	0	0	0	0
12	4	0	-1	-1	0	0	0	0	0
12	5	7	-3	-3	-7	0	0	0	0
12	6	35	9	8	-36	0	0	0	0
12	7	104	121	117	-111	0	0	0	0
12	8	70	602	607	-112	-3	-2	0	0
12	9	-869	1714	1841	728	-5	-7	0	0
12	10	-4072	2326	3035	3901	13	-18	0	0
12	11	-4468	-697	1606	5442	30	-39	0	0
12	12	201402	64829	69258	-196215	-861	830	0	0

Table A-7. (Cont.)

f) Saturn on Uranus

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	12	0	242731	0	0	0	51110	0
0	1	-44	62	4705	20817	0	0	493	4378
0	2	94	-431	-178	1683	1007	-450	-36	355
0	3	50	-5	-38	69	100	-27	-6	20
0	4	2	1	-3	2	7	-1	0	1
1	-6	0	0	0	0	0	1	0	0
1	-7	0	0	0	0	7	11	2	-1
1	-8	0	1	0	0	117	182	25	-16
1	-9	-16	27	20	3	1916	2979	378	-245
1	-4	-1359	1360	825	463	32672	50492	5424	-3492
1	-3	717272	966506	87005	-70565	724016	1031549	25154	-15568
1	-2	156144	1382322	-604240	89782	180789	1430365	-132161	23387
1	-1	-192976	58076	54052	358814	-182622	125446	5266	76457
1	0	22616	-2295	-2770	3289	14110	4389	-1372	-188
1	1	-125	-2	-81	-92	438	290	-59	30
1	2	-4	2	-4	-3	22	19	-4	2
1	3	0	0	0	0	1	1	0	0
2	-9	0	0	0	0	0	1	0	0
2	-8	0	0	0	1	-7	17	2	1
2	-7	-13	10	3	17	-108	295	32	15
2	-6	-550	4876	809	174	-1579	5888	276	-144
2	-5	-22871	22025	-8701	-7974	-21916	22148	-1868	-1784
2	-4	19433	-2805	1084	14541	19434	-1132	184	2837
2	-3	21663	10900	-11987	20130	23242	12593	-2335	4250
2	-2	15988	37163	-38411	17294	16677	37760	-8132	3793
2	-1	-8020	1864	788	7984	-7182	3632	-22	1765
2	0	564	-99	-46	9	235	93	-32	-32
2	1	-5	-2	0	-3	3	5	-1	0
3	-10	0	0	0	0	-2	3	0	0
3	-9	-5	36	8	1	-25	52	3	2
3	-8	-460	364	-126	-134	-433	366	-27	-31
3	-7	544	-29	-2	382	550	8	0	75
3	-6	572	327	-367	509	620	405	-69	107
3	-5	624	1430	-1639	495	586	1644	-326	115
3	-4	-1041	3974	-4460	-1566	-1318	4267	-923	-294
3	-3	-6607	4775	-5391	-7326	-6642	4981	-1154	-1549
3	-2	274	319	-471	190	-54	557	-124	9
3	-1	-335	70	55	329	-339	99	8	68
3	0	24	-5	-1	0	7	0	-1	-2
4	-12	0	0	0	0	-1	1	0	0
4	-11	-11	7	-2	-3	-11	8	0	-1
4	-10	15	1	-1	10	15	1	0	2
4	-9	13	9	-9	11	14	11	-2	2
4	-8	13	36	-41	8	11	42	-8	2
4	-7	-36	118	-131	-64	-55	130	-27	-11
4	-6	-336	238	-233	-445	-399	436	-51	-87
4	-5	-1196	-67	189	-1430	-1292	-126	31	-294
4	-4	-1688	-1505	183	-1939	-1751	-1498	356	-414
4	-3	-118	194	-186	-180	-200	124	-32	-67
4	-2	7	6	-11	4	-4	11	-3	0
4	-1	-17	3	3	16	-17	4	1	3
4	0	1	0	0	0	0	0	0	0
5	-12	-1	-1	0	0	-1	-1	0	0
5	-11	0	1	-1	0	0	1	0	0
5	-10	-1	3	-3	-2	-2	3	-1	0
5	-9	-9	6	-5	-13	-12	5	-1	-2
5	-8	-43	-4	14	-52	-48	-10	2	-11
5	-7	-109	-104	147	-120	-113	-125	29	-25
5	-6	-62	-422	516	-42	-51	-457	106	-11
5	-5	352	-637	732	387	344	-659	156	82
5	-4	-107	-34	56	-114	-91	-65	15	-22
5	-3	-2	7	-7	-6	-6	4	-1	-2
5	-1	-1	0	0	1	-1	0	0	0
6	-12	3	-1	0	1	3	-1	0	0
6	-11	-1	0	1	-1	-1	0	0	0
6	-10	-3	-3	5	-3	-3	-4	1	-1
6	-9	-2	-18	24	2	0	-21	5	0
6	-8	34	-53	62	50	41	-57	13	10
6	-7	157	-58	59	193	170	-57	13	40
6	-6	245	69	-72	279	252	64	-15	60
6	-5	5	-54	60	12	16	-51	12	4
6	-4	-5	0	2	-5	-4	-3	1	-1
7	-12	-2	9	-4	-1	-2	9	-1	0
7	-11	1	-2	2	2	2	-1	0	0
7	-10	8	-2	2	11	10	-2	0	2
7	-9	26	10	-16	31	28	13	-3	6
7	-8	37	58	-72	41	38	63	-15	9
7	-7	-4	93	-106	-1	-1	96	-23	0
7	-6	25	-4	1	29	25	1	0	6
7	-5	-1	-3	3	0	0	-3	1	0
7	12	0	0	0	0	0	1	0	0
8	-12	-22	-16	7	-11	-22	-15	2	-2
8	-11	2	4	-5	2	0	4	-1	0
8	-10	-2	13	-16	-4	-3	14	-3	-1
8	-9	-21	20	-24	-26	-22	21	-5	-5
8	-8	-35	7	-10	-39	-36	9	-2	-8
8	-7	4	11	-13	4	3	11	-3	1
8	-6	2	-1	0	2	2	0	0	0
8	12	-1	0	0	1	-2	0	0	0
9	-12	50	-32	15	24	50	-32	3	5
9	-11	-6	0	9	-7	-4	-2	0	-1
9	-10	-10	-7	9	-12	-11	-7	2	-3
9	-9	-6	-13	14	-8	-6	-13	3	-2
9	-8	-4	3	-3	-6	-5	2	-1	-1

Table A-7. (Cont.)
f) Saturn on Uranus

9	-7	1	1	-1	0	1	1	0	0
9	12	0	-3	-2	0	3	-4	-1	0
10	-12	17	88	-42	8	17	88	-9	2
10	-11	2	-3	5	3	3	1	1	1
10	-10	5	-3	4	4	5	-3	1	1
10	-9	-1	-1	2	-2	-1	-1	0	0
10	-8	0	1	0	0	0	1	0	0
10	12	5	4	3	-3	5	8	1	-1
11	-12	-79	-11	5	-37	-80	-11	1	-8
11	-11	0	2	-1	1	-3	2	0	0
11	-10	0	0	1	1	-1	0	0	0
11	-9	-1	0	0	0	-1	0	0	0
11	12	-9	7	4	5	-12	6	1	2
12	-12	9	-29	14	6	9	-29	3	1
12	-11	-2	-1	0	1	-2	-3	0	0
12	-10	-1	-1	0	0	-1	-1	0	0
12	-9	0	-1	0	0	0	-1	0	0
12	11	0	1	0	0	0	1	0	0
12	12	-1	3	1	0	0	2	0	0

Table A-7. (Cont.)
 Secular Terms
 f) Saturn on Uranus

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	176457802	0	-214850822	0	6615297	0
1	4136281	1682410	1679286	6899282	-93945486	81119914
2	-58560626	71538288	-71459462	-58495861	-2201866	1901613
3	-4121366	5029153	-5026381	-4119089	-77414	66863
4	-257682	314325	-314209	-257587	-3226	2786
5	-15731	19186	-19181	-15727	-148	128
6	-956	1166	-1165	-956	-7	6
7	-58	71	-71	-58	0	0
8	-4	4	-4	-4	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	70644	0	14508	0	34740	0
1	-1505634	-1237268	618629	-752814	-493356	426002
2	-17648	-14498	14502	-17646	-11563	9986
3	-412	-341	510	-619	-407	351
4	-14	-10	18	-26	-17	15
5	0	-1	0	-1	-1	1
6	2	0	0	-1	0	0
7	-4	3	0	2	0	0
8	1	0	1	1	0	0
9	3	0	0	2	0	0
10	-2	1	0	1	0	0
11	1	0	0	1	0	0
12	0	1	1	0	0	0

Table A-7. (Cont.)
Periodic Terms
g) Neptune on Uranus

		DX		DY		DZ		U/COS(11)	
		(IN UNITS OF 10**(-12))							
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	175014341	0	13075817	0	-1192604	0	-128	0
0	1	-75320641	2686	-182502	-70674210	0	0	0	0
0	2	-40646354	-2833806	2830407	-40631022	87834	863317	9	93
0	3	-3211251	-248696	248318	-3208050	1997	6290	0	1
0	4	-206407	-16809	16909	-206493	71	786	0	0
0	5	-12644	-934	896	-12625	3	21	0	0
0	6	-880	-129	140	-886	0	0	0	0
0	7	-78	19	-22	-7	0	0	0	0
0	8	-7	2	8	-7	0	0	0	0
0	9	0	7	-2	0	0	0	0	0
1	-10	1	1	2	-1	0	0	0	0
1	-9	-2	-11	-11	2	0	0	0	0
1	-8	39	-10	-7	-41	0	0	0	0
1	-7	515	-857	-870	-510	-2	-1	0	0
1	-6	8639	-11986	-11926	-8650	-10	-16	0	0
1	-5	144720	-208042	-208197	-144680	-205	-298	0	0
1	-4	2498797	-3533498	-3531432	-2497605	-8773	-10054	-1	-1
1	-3	42207714	-59639859	-59620080	-42193453	-80974	-145304	-9	-16
1	-2	680597215	-968903742	-967361597	-679415765	-11360021	-17773344	-1222	-1374
1	-1	95476591	-96142753	-119730318	-114010878	3310053	-1613696	356	-174
1	0	-1180123689	1683410912	-1686859238	-1183420910	-28407171	-11008637	-3076	-1184
1	1	-106290014	126993563	-126825141	-106149791	-3381700	-1804202	-366	-194
1	2	-5900242	6911524	-6910531	-5899394	-50129	-18273	-5	-2
1	3	-344254	399518	-399305	-343959	-3154	-1658	0	0
1	4	-20159	23130	-23132	-20200	-107	-47	0	0
1	5	-1091	1327	-1327	-1079	-5	-2	0	0
1	6	-98	84	-83	-100	0	0	0	0
1	7	3	5	-5	4	0	0	0	0
1	8	-2	0	0	-2	0	0	0	0
2	-11	0	3	3	0	0	0	0	0
2	-10	31	60	60	-32	0	0	0	0
2	-9	318	926	925	-315	0	0	0	0
2	-8	5934	15460	15460	-5949	2	-1	0	0
2	-7	94982	251325	251240	-94899	7	6	0	0
2	-6	1557891	4105882	4104785	-1557628	214	70	0	0
2	-5	25218645	66253114	66225476	-25208058	6587	1070	1	0
2	-4	393563682	1026658714	1026007453	-393321118	99686	39516	11	4
2	-3	5151319700	13117800325	13098471383	-5144172408	6077655	420456	654	45
2	-2	-42819937119	-138744070340	-139584527720	43134117604	4101580	45368722	4410	4878
2	-1	-21013886264	-57459948807	-57818335360	-21072422150	10297278	-13384439	1107	-1439
2	0	41209551605	133767988710	-133694540670	41186438361	135737233	-49047782	14566	-7425
2	1	1952097344	6307430762	-6305104156	1951365938	3049078	-1574909	328	-170
2	2	103296542	333229341	-333137638	103267821	111767	-56736	17	-6
2	3	57490111	18531704	-18525752	5747853	4560	-7347	0	0
2	4	329304	1061149	-1060963	329237	211	-108	0	0
2	5	19233	61889	-61877	19232	11	-5	0	0
2	6	1133	3665	-3665	1132	0	0	0	0
2	7	49	218	-217	49	0	0	0	0
2	8	4	13	-13	4	0	0	0	0
3	-12	1	-2	-2	-1	0	0	0	0
3	-11	-7	8	8	7	0	0	0	0
3	-10	62	-19	-22	-64	0	0	0	0
3	-9	270	159	172	-206	0	3	0	0
3	-8	6390	1502	1461	-6453	-2	-7	0	0
3	-7	92874	25325	25419	-92603	-60	106	0	0
3	-6	1457565	397664	397432	-1458013	-1480	2716	0	0
3	-5	21504058	5997811	5994823	-21493631	-27793	40255	-2	4
3	-4	265556066	77699060	77684289	-265521790	-914626	1810004	-98	195
3	-3	594214360	281931262	279172217	-591862417	1888579	-869111	203	-93
3	-2	-1042650202	-278580714	-269882547	-1032213422	-73255	26868301	-83	2889
3	-1	-1074507308	-502236903	-502481226	-1074852046	1513096	-9055275	163	-974
3	0	-38505083	-17147495	-17136438	-38482797	200698	-704584	22	-76
3	1	-173358	-749030	-749145	-173354	1765	-11210	0	-1
3	2	-93523	-40388	-40343	-93480	198	-698	0	0
3	3	-5276	-2291	-2301	-5228	5	-24	0	0
3	4	-288	-109	-107	-288	0	-1	0	0
3	5	-19	13	14	-19	0	0	0	0
3	6	0	0	-1	0	0	0	0	0
4	-13	0	2	2	0	0	0	0	0
4	-12	-2	-11	-12	3	0	0	0	0
4	-11	-11	59	63	10	0	0	0	0
4	-10	-106	-75	-95	-109	-3	-2	0	0
4	-9	-2599	2242	2328	2403	4	0	0	0
4	-8	-36542	25881	25577	-36490	-65	-110	0	0
4	-7	-580777	411800	412762	-581212	-1231	-2112	0	0
4	-6	-8727864	6023134	6024134	-8727628	-20886	-33769	-2	-4
4	-5	-120355522	79572601	79697525	-120454544	-547364	-891050	-59	-96
4	-4	-1233603903	756918914	760776276	-1235824516	-3900801	-1641341	-365	-176
4	-3	-6429274875	-2439084381	-2446535409	-6103651650	-155175384	-111994239	-16686	-12043
4	-2	-4402410834	-2501760948	-2507484140	-4414473705	13578335	10648525	1460	1145
4	-1	-5805447072	-2095918187	-2094718954	-5802130334	6968744	9456330	749	1017
4	0	-278611016	100558210	-100519971	-278505276	153522	207611	17	72
4	1	-14796942	5340201	-5338704	-14792837	5770	7858	1	0
4	2	-825268	297850	-297786	-825074	234	310	0	0
4	3	-47354	17079	-17074	-47347	11	15	0	0
4	4	-2760	999	-1000	-2759	0	0	0	0
4	5	-165	58	-58	-165	0	0	0	0
4	6	-10	4	-4	-10	0	0	0	0
5	-14	-2	0	0	2	0	0	0	0
5	-13	12	6	6	-12	0	0	0	0
5	-12	-67	-38	-39	52	0	0	0	0
5	-11	143	132	142	-162	3	-1	0	0
5	-10	-432	-1049	-1110	511	-5	3	0	0
5	-9	-654	-4922	-4684	411	108	10	0	0
5	-8	-1493	-83682	-85022	15607	1574	185	0	0
5	-7	-161261	-872160	-877725	162381	23223	2603	7	0
5	-6	-1320379	-5181048	-5399273	1365582	419801	57629	45	6
5	-5	-5987877	5697671	52050903	-6754002	-708123	-67100	-76	-7
5	-4	-17654647	185790184	7132304	-33527531	-8718694	3155818	-938	339
5	-3	21971736	-216116839	211962377	19584056	-4407336	407232	-474	43
5	-2	44883112	-172714725	172747162	44897198	1494963	-23590	161	-3
5	-1	1149778	-5959216	5952569	1149252	107175	9557	12	1

Table A-7. (Cont.)

g) Neptune on Uranus

5	0	39614	-235975	236006	39650	1575	-78	0	0
5	1	2041	-12605	17596	2033	111	10	0	0
5	2	119	-100	701	121	4	0	0	0
5	3	2	-36	36	7	0	0	0	0
5	4	1	-3	3	1	0	0	0	0
6	-15	2	-1	-2	-2	0	0	0	0
6	-14	-13	7	13	0	0	0	0	0
6	-13	65	-20	-23	-68	0	-1	0	0
6	-12	-742	39	50	264	0	4	0	0
6	-11	1017	145	111	-1126	0	-8	0	0
6	-10	778	586	647	-317	-63	80	0	0
6	-9	32948	14611	14850	-36715	-748	888	0	0
6	-8	282155	116965	119075	-286951	-10257	12075	-1	1
6	-7	1287925	282078	352245	-1458807	-142902	154854	-15	17
6	-6	-16092952	-15397259	-14101589	12951946	237060	-270549	25	-29
6	-5	-138752620	-141602800	-105808657	76179917	901570	-2974477	97	-420
6	-4	270305049	420079265	350478549	-187333838	13945017	-25048505	1424	-2693
6	-3	335713818	401855033	-402254978	336213422	-1322454	2292299	-162	746
6	-2	-200670528	-343109567	342904696	-200551512	-782066	844758	-84	91
6	-1	-9802235	-16790857	16784262	-9798391	-15866	17855	-2	2
6	0	-521012	-896431	896186	-522885	-661	707	0	0
6	1	-29260	-50154	50141	-24255	-25	78	0	0
6	2	-1681	-2887	2887	-1680	-1	0	0	0
6	3	-98	-168	167	-98	0	0	0	0
6	4	-6	-10	10	-6	0	0	0	0
7	-16	0	3	3	0	0	0	0	0
7	-15	2	-13	-18	-1	0	0	0	0
7	-14	-23	72	77	23	0	0	0	0
7	-13	133	-263	-290	-137	-3	0	0	0
7	-12	-717	828	951	758	7	81	0	0
7	-11	658	-807	-1244	-878	-33	-91	0	0
7	-10	-17347	9608	11153	18777	-233	-794	0	0
7	-9	-118744	66070	67839	121853	-2760	-10105	0	-1
7	-8	-594773	307479	386471	715005	-23174	-105394	-2	-11
7	-7	2645773	-1166122	-11484	-822044	40447	175282	4	19
7	-6	484015	-619271	7439172	23784955	88811	623652	63	62
7	-5	-37598108	4529327	-6762189	-7011981	-1177034	-2238576	-127	-741
7	-4	37182855	-2756877	3030826	36346882	-155633	-624836	-17	-67
7	-3	26907595	1824200	-1824710	26910439	46234	228009	5	25
7	-2	836142	6249	-6269	835825	1600	15456	0	2
7	-1	34135	-1325	1318	34144	56	214	0	0
7	0	1817	-84	85	1815	2	17	0	0
7	1	102	-3	3	102	0	0	0	0
7	2	5	-1	1	5	0	0	0	0
7	16	-1	-7	-7	1	0	0	0	0
8	-16	11	11	12	-14	2	-1	0	0
8	-15	-41	-59	-77	66	-1	0	0	0
8	-14	163	308	327	-183	5	-1	0	0
8	-13	-332	-1202	-1320	420	-13	1	0	0
8	-12	280	2354	2844	-552	89	23	0	0
8	-11	1417	-12479	-14804	-832	538	166	0	0
8	-10	3759	-51601	-52895	-4146	6398	2258	1	0
8	-9	30174	-205184	-314680	-32795	51543	21485	6	2
8	-8	-197597	1272362	-66066	133763	-94764	-37009	-10	-4
8	-7	527414	4795291	-9838858	-2934206	-867707	62684	-39	7
8	-6	16051548	-25126979	-9569609	-8651526	835012	115177	90	12
8	-5	-32981757	33758888	16004281	22854999	3554335	1194580	382	128
8	-4	-38079043	46097308	-46139266	-38082506	-344304	-129617	-37	-14
8	-3	23876180	-20661036	20648259	23861219	-106628	-66387	-11	-7
8	-2	1192715	-1029341	1028921	1192226	-2156	-1261	0	0
8	-1	63985	-55178	55163	63969	-91	-57	0	0
8	0	3590	-3096	3096	3589	-3	-2	0	0
8	1	208	-178	178	208	0	0	0	0
8	2	12	-10	10	12	0	0	0	0
8	16	-14	-24	-24	34	0	0	0	0
9	-16	87	-1	-10	-108	2	-12	0	0
9	-15	-329	-67	-31	506	-2	5	0	0
9	-14	1392	473	470	-1547	9	-15	0	0
9	-13	-3025	-1710	-1794	3703	-68	61	0	0
9	-12	7724	6980	7938	-10339	-274	278	0	0
9	-11	14302	9002	8664	-12937	-3546	2555	0	0
9	-10	37960	37580	8719196	-105358	-24690	15629	-2	0
9	-9	-4485148	-448959	30686	-163099	48539	-33130	5	-4
9	-8	-2400356	-2163885	2860819	-2765593	68190	-155295	7	-17
9	-7	2532878	2746758	-5782027	3303156	-198858	231774	-21	25
9	-6	-2072149	-6404938	1702908	-1527419	410267	-308891	44	-33
9	-5	1540463	5891374	-5758162	1557882	82857	-35808	9	-4
9	-4	492413	4064164	-4064150	492416	-32956	13414	-4	1
9	-3	22940	124951	-124905	22928	-7136	651	0	0
9	-2	1180	5031	-5032	1179	-28	14	0	0
9	-1	65	265	-265	65	0	0	0	0
9	0	3	15	-15	3	0	0	0	0
9	15	-3	0	0	0	0	0	0	0
9	16	-237	47	47	237	0	3	0	0
10	-16	305	-307	-431	-350	-30	-48	0	0
10	-15	-1175	704	1525	1729	8	18	0	0
10	-14	4203	-2006	-2552	-4712	-13	-93	0	0
10	-13	-10604	2357	4251	13259	-28	-192	0	0
10	-12	273	3411	1334	-3957	-7	-2805	0	0
10	-11	-5940	-2385	18564	68521	714	-15394	0	-2
10	-10	334449	-79079	70486	131193	-55	34398	0	4
10	-9	1618623	-368412	323512	1920788	44406	67012	5	7
10	-8	-2273542	156769	204282	-3104416	-37747	-141587	-4	-15
10	-7	4309447	1593020	754929	-47790	5115	174443	1	19
10	-6	-4330528	-2720186	-1555753	1180915	-73648	487930	-8	52
10	-5	-634547	-3494999	3491859	-6347166	9389	-49550	1	-5
10	-4	2210517	1760492	-1759331	2209088	5213	-15966	0	-1
10	-3	117615	89977	-89938	112567	90	-263	0	0
10	-2	6068	4853	-4851	6066	5	-12	0	0
10	-1	342	273	-273	342	0	0	0	0
10	0	20	16	-16	20	0	0	0	0
10	1	1	0	0	1	0	0	0	0
10	15	-14	10	10	14	0	0	0	0
10	16	-735	1091	1092	735	11	13	0	0
11	-16	38	-1818	-2616	260	-196	-37	0	0
11	-15	-1384	4082	8584	393	87	44	0	0
11	-14	4915	-12125	-15709	-4909	62	13	0	0
11	-13	-7292	6616	13945	8269	1490	1079	0	0
11	-12	950	10266	-42913	-17184	6481	4965	1	1
11	-11	-57412	168189	-105497	-23115	-16727	-11517	-2	-1
11	-10	-31943	7931114	-892771	-421962	-39092	869	0	0
11	-9	781582	-1137613	1218384	889727	70585	25031	8	3
11	-8	-602430	694164	-910309	-1068285	-60447	-37676	-6	-4
11	-7	985464	-538859	316992	281011	68209	64078	7	7

Table A-7. (Cont.)
g) Neptune on Uranus

11	-6	-886412	418349	-416793	-865198	6746	10357	1	1
11	-5	-594497	190288	-190294	-594493	-2939	-4540	0	0
11	-4	-18314	7069	-7066	-18308	-150	-283	0	0
11	-3	-742	326	-326	-742	-3	-4	0	0
11	-2	-39	18	-18	-39	0	0	0	0
11	-1	-2	0	0	-2	0	0	0	0
11	15	-14	37	38	14	1	0	0	0
11	16	1311	5931	5936	-1313	78	5	0	0
12	-16	-4448	-5106	-6097	7484	-754	439	0	0
12	-15	1951	9061	21150	-19750	45	11	0	0
12	-14	-4809	-17233	-24050	11772	-1211	371	0	0
12	-13	-11792	-6792	34219	-19532	-6112	1361	0	0
12	-12	-56316	-62989	53416	-44316	11365	-4350	1	0
12	-11	-244790	-375190	443776	-254428	9790	-16689	1	-2
12	-10	268393	717293	-769136	269247	-31973	23406	-3	3
12	-9	-114645	-575426	711085	-84748	33656	-14504	4	-2
12	-8	-104834	695586	-86053	89311	-31552	6459	-3	1
12	-7	206849	-582579	-45077	-113283	-61460	1676	-7	0
12	-6	281542	-862117	862329	281085	6914	66	1	0
12	-5	-127730	238810	-238649	-127142	1724	305	0	0
12	-4	-6650	12429	-12423	-6647	32	4	0	0
12	-3	-360	672	-672	-360	2	0	0	0
12	-2	-20	38	-38	-20	0	0	0	0
12	-1	-1	2	-2	-1	0	0	0	0
12	13	-3	0	0	0	0	0	0	0
12	14	6	12	12	-6	0	0	0	0
12	15	109	279	279	-109	3	-2	0	0
12	16	23220	15716	15722	-23242	226	-199	0	0
13	-16	-12867	-3602	4556	36275	-394	1023	0	0
13	-15	492	13220	292	-63522	337	-873	0	0
13	-14	9495	-7671	-48247	40247	568	-2713	0	0
13	-13	25288	-14520	1213	39176	-1751	7236	0	1
13	-12	237617	8273	-27235	273478	4655	8472	1	1
13	-11	-412528	-104463	116531	-429148	-754	-21527	0	-2
13	-10	330865	158810	-176309	349582	-3947	19600	0	2
13	-9	-151791	-95559	161919	-198933	5413	-13067	1	-1
13	-8	116144	141276	-60111	61786	-8784	13466	-1	1
13	-7	-90673	-125262	122346	-89918	-1231	1148	1	0
13	-6	-45802	-83952	83945	-45798	591	-566	0	0
13	-5	-1614	-2611	2610	-1614	36	-29	0	0
13	-4	-72	-107	107	-72	0	0	0	0
13	-3	-4	-6	6	-4	0	0	0	0
13	-2	1	-2	2	0	0	0	0	0
13	-1	-74	15	15	23	0	0	0	0
13	13	-110	40	40	110	0	-4	0	0
13	14	-1441	900	899	1488	4	-15	0	0
13	15	82313	-17090	-17145	-82459	101	-1088	0	0
14	-16	-30302	19993	47878	39303	2911	4916	0	1
14	-15	-47072	90667	-114113	-90289	925	903	0	0
14	-14	21917	2705	-17976	-14139	-3151	-3524	0	0
14	-13	-79988	103764	-116883	-107379	-6834	-56	-1	0
14	-12	175329	-156404	156146	180783	10128	6370	1	-1
14	-11	-194010	108339	-110667	-205595	-7830	-8099	-1	0
14	-10	110043	-40759	40004	130131	4131	6464	0	1
14	-9	-108972	5766	-15927	-24797	-2044	-5150	0	-1
14	-8	78615	10105	10842	6327	-1739	-8184	0	-1
14	-7	116563	14632	-14572	116533	164	941	0	0
14	-6	-26297	-8196	8190	-26279	4	214	0	0
14	-5	-1402	-439	439	-1401	0	4	0	0
14	-4	-76	-24	24	-76	0	0	0	0
14	-3	-4	-1	1	-4	0	0	0	0
14	-2	0	3	3	0	0	0	0	0
14	-1	0	-17	-17	0	0	0	0	0
14	13	3	72	72	-3	1	0	0	0
14	14	199	-311	-312	-200	-13	-7	0	0
14	15	3254	-2172	-2193	-3261	-1	-18	0	0
14	16	172482	-256590	-256869	-172573	-1317	-1825	0	0
15	-16	-85418	-150857	230275	-77733	-2589	1906	0	0
15	-15	-7621	155271	-97132	7079	3148	-362	0	0
15	-14	-20016	-69444	97538	-14833	1093	-2118	0	0
15	-13	16844	120806	-119624	16981	-6224	2719	-1	0
15	-12	14487	-137812	143665	6387	-1071	-1071	0	0
15	-11	-20473	70863	-73661	-22453	-4417	-175	0	0
15	-10	17767	-30850	40590	21962	2479	560	0	0
15	-9	-18530	21955	-10394	-4436	-7495	-1044	0	0
15	-8	16907	-18062	17863	16502	-176	-136	0	0
15	-7	11377	-9391	9390	11376	101	72	0	0
15	-6	358	-328	327	358	5	4	0	0
15	-5	15	-15	15	15	0	0	0	0
15	-4	-3	0	0	0	0	0	0	0
15	-3	17	11	11	-17	0	0	0	0
15	-2	-59	-35	-34	59	-4	3	0	0
15	-1	373	554	554	-372	15	-8	0	0
15	13	1450	3274	3286	-1460	-51	13	0	0
15	14	26777	53117	53121	-26738	-55	-24	0	0
15	15	-22781	-358519	-360759	23693	-5818	-884	-1	0
16	-16	84950	-55812	3178	138049	-6316	12500	-1	1
16	-15	200698	112987	-135327	222308	667	1065	0	0
16	-14	-38859	-13293	9681	-35599	745	-3889	0	0
16	-13	68643	60136	-63423	70759	-1583	3409	0	0
16	-12	-27622	-34607	35883	-27968	1591	-2108	0	0
16	-11	11701	19981	-23144	12261	-1057	958	0	0
16	-10	-3879	-15788	15788	4411	-3104	-693	0	0
16	-9	955	10746	-2455	1741	1014	-616	0	0
16	-8	957	15331	-15329	964	-124	46	0	0
16	-7	357	-2838	2836	357	-27	6	0	0
16	-6	20	-155	155	20	0	0	0	0
16	-5	1	-8	8	1	0	0	0	0
16	-4	2	-2	-2	0	0	0	0	0
16	-3	-19	8	8	19	0	0	0	0
16	-2	94	-29	-29	-93	0	-6	0	0
16	-1	-485	47	47	484	-3	21	0	0
16	13	808	74	74	-880	20	-62	0	0
16	14	-7038	-578	-584	7093	-64	103	0	0
16	15	-47625	2475	2403	48153	88	-186	0	0
16	16	-457761	-292961	-293791	458674	-1494	-2648	0	0

Table A-7. (Cont.)

g) Neptune on Uranus

		ND7		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC		(IN UNITS OF 10**(-9))			
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-160	0	115145	0	0	0	23831	0
0	1	-4	11631	-33095	-2311	0	0	-6278	-486
0	2	-6	556	-3984	-244	-145	2870	-916	-60
0	3	-1	20	-307	-19	-21	357	-85	-5
0	4	0	1	-22	-1	-2	34	-7	0
0	5	0	0	-2	0	0	3	-1	0
1	-5	0	0	0	1	-5	-3	-1	1
1	-4	-3	-2	-7	10	-76	-53	-8	11
1	-3	-75	-48	-109	166	-1160	-812	-113	162
1	-2	-5267	-3784	-3111	4424	-18735	-13254	-1651	2367
1	-1	-285242	-200044	-55364	78646	-286064	-200854	-11710	16603
1	0	-15625	-16004	5123	-5143	-28666	-25353	2058	-2482
1	1	-427	-418	483	-520	-2050	-1803	256	-293
1	2	-5	-6	21	-22	-132	-116	17	-20
1	3	0	0	1	-2	-39	-8	1	-1
1	4	0	0	0	0	-1	-1	0	0
2	-7	0	0	0	0	6	-2	0	-1
2	-6	3	-1	-2	-7	95	-36	-5	-14
2	-5	70	-26	-51	-142	1528	-574	-83	-221
2	-4	2217	-808	-1219	-3354	24655	-9262	-1271	-3385
2	-3	95692	-34731	-34677	-95489	404853	-152087	-19108	-50886
2	-2	831541	-3040283	-1500137	-4111870	6939449	-2610360	-270276	-718378
2	-1	-2978004	9202224	-154637	-474281	-29372078	9059732	-17547	-58703
2	0	3169	2349	-1038	646	-1368994	425461	-44565	-143774
2	1	-6	32	-73	-138	-80311	24917	-3139	-10147
2	2	-2	1	-1	-14	-4906	1519	-209	-675
2	3	0	0	0	-1	-305	94	-14	-44
2	4	0	0	0	0	-19	6	-1	-3
2	5	0	0	0	0	-1	0	0	0
3	-7	0	0	0	0	1	-3	0	0
3	-6	1	-3	-6	-1	11	-40	-6	-2
3	-5	21	-91	-132	-32	149	-638	-94	-25
3	-4	649	-2873	-3086	-736	2429	-9897	-1395	-367
3	-3	32204	-139014	-89037	-23863	41052	-147085	-19570	-5624
3	-2	82205	-171686	-48393	-22875	83853	-178021	-4993	-4625
3	-1	-1649	2883	-1131	-639	2338	-5651	671	288
3	0	-2	5	41	23	145	-381	60	27
3	1	0	0	2	1	11	-25	4	2
3	2	0	0	0	0	1	-2	0	0
4	-8	0	0	0	0	1	1	0	0
4	-7	1	2	5	-4	17	21	3	-3
4	-6	41	46	86	-75	244	315	49	-38
4	-5	1033	1171	1494	-1285	3301	4499	669	-515
4	-4	30229	38161	28519	-22352	43470	61363	8487	-6160
4	-3	347833	613415	265588	-141348	324050	556951	49705	-27572
4	-2	-491310	-1331887	134989	-80454	-473305	-1300621	25021	-14464
4	-1	-319	-1063	7138	-4647	-25291	-66050	8284	-3570
4	0	-5	-16	486	-322	-1658	-4133	607	-267
4	1	0	-1	33	-22	-112	-268	42	-19
4	2	0	0	2	-2	-8	-18	3	-1
4	3	0	0	0	0	-1	-1	0	0
5	-8	-1	0	0	2	-4	1	0	1
5	-7	-26	5	6	32	-68	12	2	12
5	-6	-495	89	87	521	-858	143	24	147
5	-5	-9693	975	805	7680	-8321	1135	186	1464
5	-4	28952	2826	1868	-17391	29681	3208	424	-3840
5	-3	27091	7391	1825	-6397	28416	7508	369	-1200
5	-2	-678	-278	100	-210	744	87	-18	109
5	-1	-6	-3	0	6	90	6	-2	9
5	0	0	0	0	0	3	0	0	1
6	-9	0	0	-1	-1	1	-2	0	0
6	-8	7	-16	-19	-8	15	-35	-6	-3
6	-7	114	-251	-263	-122	172	-377	-69	-32
6	-6	1871	-3369	-2809	-1533	1437	-2919	-542	-276
6	-5	-6268	7115	5055	4506	-8341	8755	1280	1194
6	-4	-55769	46194	18090	22734	-52570	44461	3575	4404
6	-3	81824	-49225	8504	11866	78918	-46769	1521	2181
6	-2	174	-104	484	663	4277	-2565	353	597
6	-1	4	-3	34	45	274	-171	27	42
6	0	0	0	2	3	18	-12	2	3
6	1	0	0	0	0	1	-1	0	0
7	-10	0	0	1	-1	1	1	0	0
7	-9	7	11	12	-7	12	21	4	-2
7	-8	81	136	148	-86	115	204	38	-21
7	-7	749	1551	1368	-666	725	1459	277	-137
7	-6	-672	-2522	-1884	484	-621	-2211	-379	104
7	-5	402	5011	2912	-200	354	5074	646	-44
7	-4	-337	4224	911	83	-317	4453	166	19
7	-3	25	-120	37	10	11	106	-17	1
7	-2	0	-1	-1	0	1	7	-1	0
8	-11	0	0	0	1	-1	0	0	0
8	-10	-9	0	0	99	-15	-1	0	3
8	-9	-91	-6	-8	9	-125	-11	-2	24
8	-8	-786	-125	-111	714	-745	-110	-22	145
8	-7	1110	404	327	-876	990	345	64	-180
8	-6	-1385	-833	-584	952	-1584	-1023	-148	234
8	-5	-6371	-5302	-2096	2433	-6210	-5089	-412	485
8	-4	5288	5913	-984	974	4948	5635	-177	168
8	-3	17	20	-55	54	276	311	-41	37
8	-2	0	0	-4	4	19	20	-3	3
8	-1	0	0	0	0	1	1	0	0

Table A-7. (Cont.)

g) Neptune on Uranus

9	-12	0	0	-1	0	0	0	0	0
9	-11	4	-5	-5	-6	4	-8	-1	-1
9	-10	32	-51	-25	-37	44	-53	-11	-9
9	-9	265	-276	-256	-263	746	-263	-52	-69
9	-8	-480	356	277	405	-449	314	59	85
9	-7	469	-214	-149	-335	-609	-191	-32	-69
9	-6	-798	214	114	493	-803	207	74	101
9	-5	-641	70	13	129	-677	80	2	73
9	-4	19	0	-1	6	-14	5	-1	-3
9	-3	0	0	0	0	-1	0	0	0
10	-13	0	-1	0	0	0	0	0	0
10	-12	2	5	4	-1	2	7	1	0
10	-11	9	28	33	-9	11	36	8	-2
10	-10	37	186	174	-36	38	174	35	-8
10	-9	0	-301	-261	-2	0	-287	-55	0
10	-8	-45	249	188	37	-40	222	40	7
10	-7	91	-244	-164	-63	109	-268	-40	-16
10	-6	489	-880	-331	-190	474	-866	-66	-38
10	-5	-451	590	-115	-81	-625	543	-19	-14
10	-4	-2	3	-6	-5	-24	31	-4	-3
10	-3	0	0	0	0	-2	2	0	0
11	-15	-1	0	0	0	0	0	0	0
11	-14	1	0	0	0	1	0	0	0
11	-13	-5	-2	-1	2	-6	-2	-7	1
11	-12	-15	-4	-7	19	-19	-6	-2	4
11	-11	-88	-39	-35	83	-83	-32	-7	17
11	-10	131	91	82	-116	123	85	17	-24
11	-9	-95	-97	-78	75	-87	-90	-17	16
11	-8	52	74	52	-35	45	64	11	-8
11	-7	-58	-121	-68	31	-57	-121	-15	7
11	-6	-29	-95	-18	5	-37	-100	-3	1
11	-5	0	3	-1	0	-1	-2	0	0
11	-4	1	0	0	1	1	0	0	0
12	-16	1	-1	-1	-1	1	-1	0	0
12	-15	-1	1	0	0	-1	1	0	0
12	-14	4	-3	-1	-1	4	-3	0	0
12	-13	5	-5	-7	-10	7	-6	-2	-2
12	-12	43	-26	-25	-39	40	-25	-5	-8
12	-11	-80	30	27	75	-75	28	6	16
12	-10	75	-13	-9	-61	69	-11	-2	-13
12	-9	-46	0	-1	35	-61	0	0	7
12	-8	41	7	5	-27	44	9	1	-6
12	-7	120	40	15	-44	119	39	3	-9
12	-6	-67	-33	6	-14	-60	-31	1	-2
12	-5	0	0	0	-1	-3	-2	0	0
12	-4	2	-2	2	2	2	-2	1	0
13	-17	0	1	1	0	0	1	0	0
13	-16	-1	-4	-3	1	-1	-3	-1	0
13	-15	0	6	0	0	0	6	0	0
13	-14	2	0	8	0	2	2	2	0
13	-13	-2	28	-24	1	-2	26	5	0
13	-12	11	-45	-44	-12	10	-42	-9	-2
13	-11	-19	40	32	16	-18	37	7	3
13	-10	15	-21	-16	-12	14	-19	-4	-3
13	-9	-11	11	7	7	-9	9	2	2
13	-8	17	-13	-7	-10	17	-12	-2	-2
13	-7	13	-7	-1	-2	14	-8	0	0
13	-6	0	1	0	0	0	0	0	0
13	17	0	0	0	0	0	0	0	0
13	17	-2	-9	9	-2	-2	-9	2	0
13	18	0	-1	1	0	0	-1	0	0
14	-17	1	0	0	-1	1	0	0	0
14	-16	-11	-8	-7	11	-11	-7	-2	2
14	-15	3	5	-4	5	2	4	-1	1
14	-14	-13	-12	-7	10	-12	-11	2	2
14	-13	14	17	20	-17	15	14	4	-4
14	-12	-13	-23	-19	10	-12	-22	-4	2
14	-11	5	14	12	-4	4	12	3	-1
14	-10	-1	-8	-6	1	-1	-7	-1	0
14	-9	0	6	4	0	0	7	1	0
14	-8	-2	16	6	1	-2	16	1	0
14	-7	2	-8	2	0	2	-7	0	0
14	-6	2	1	0	0	0	0	0	0
14	-5	-28	-19	19	-28	-28	-19	6	-6
14	-4	-1	-1	1	-2	-2	-2	0	0
15	-18	0	0	0	-1	1	-1	0	0
15	-17	20	-9	-9	-20	20	-9	-2	-4
15	-16	-15	1	0	13	-14	0	0	3
15	-15	14	-1	-2	-4	13	-1	0	-1
15	-14	-10	2	1	15	-8	2	0	3
15	-13	17	2	1	-13	16	2	0	-3
15	-12	-8	-2	-2	7	-7	-2	0	2
15	-11	4	2	2	-3	4	2	0	-1
15	-10	-2	-1	-1	1	-2	-1	0	0
15	-9	2	2	1	-1	2	2	0	0
15	-8	1	2	0	0	2	2	0	0
15	-7	9	-3	3	6	7	-3	1	1
15	-6	-39	2	-2	-38	-38	2	0	-8
15	-5	-1	0	0	-2	-3	0	0	-1
16	-18	0	0	1	0	0	1	0	0
16	-17	3	13	13	-3	2	14	3	0
16	-16	-13	22	23	13	-13	22	5	3
16	-15	-1	-2	-6	-4	-2	-1	-1	-1
16	-14	-8	9	6	5	-8	8	1	1
16	-13	4	-3	-3	-4	3	-3	-1	-1
16	-12	-3	2	1	2	-2	1	0	0
16	-11	1	0	0	-1	1	0	0	0
16	-10	-1	0	0	1	-1	0	0	0
16	-9	-2	0	0	1	-2	0	0	0
16	-8	1	0	0	0	1	0	0	0
16	-7	0	0	-1	0	0	0	0	0
16	-6	3	1	-5	0	1	4	-1	0
16	-5	-32	49	-49	-32	-31	49	-10	-7
16	-4	-1	1	-2	-1	-2	3	-1	0

Table A-7. (Cont.)
 Secular Terms
 g) Neptune on Uranus

J	DX (IN UNITS OF $10^{**}(-16)$) (TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)		DY (IN UNITS OF $10^{**}(-16)$) (TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)		DZ (IN UNITS OF $10^{**}(-16)$) (TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)	
	COS	SIN	COS	SIN	COS	SIN
0	8205898	0	-81314370	0	1937083	0
1	192546	634456	637840	321035	-27508994	6515736
2	-2723272	27074916	-27045082	-2770260	-644748	152742
3	-191658	1903373	-1907324	-191552	-22668	5371
4	-11983	118962	-118918	-11979	-945	224
5	-732	7261	-7259	-731	-43	10
6	-44	441	-441	-44	-2	0
7	-3	27	-27	-3	0	0
8	0	2	-2	0	0	0

NDZ
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$
 WHERE N =THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T =TIME IN DAYS FROM EPOCH)

J	NDZ (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$ WHERE N =THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T =TIME IN DAYS FROM EPOCH)		NU (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$ WHERE N =THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T =TIME IN DAYS FROM EPOCH)		U/COS(I) (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY $N*T$ WHERE N =THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T =TIME IN DAYS FROM EPOCH)	
	COS	SIN	COS	SIN	COS	SIN
0	26750	0	665	0	10173	0
1	-569836	-57537	28768	-284914	-144464	34217
2	-6681	-674	678	-6679	-3386	802
3	-154	-17	24	-232	-119	28
4	-7	-1	-2	-10	-5	1
5	1	2	0	-1	0	0
6	1	0	1	1	0	0
7	-1	1	0	0	0	0
8	0	-1	3	2	0	0
9	2	-2	0	0	0	0
10	1	3	0	1	0	0
11	-2	-1	2	0	0	0
12	-2	-2	0	1	0	0
13	0	2	-3	2	0	0
14	2	-3	1	-1	0	0
15	-3	1	-1	0	0	0
16	3	0	-2	2	0	0
17	-1	0	1	0	0	0
18	-2	-3	-1	-1	0	0
19	0	-2	1	-1	0	0
20	2	2	0	1	0	0

Table A-8. Neptune
Periodic Terms
a) Mercury on Neptune

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-25827	0	-2594	0	-1714	0	0	0	
0	1	1689156	38	-51	1689156	0	0	0	0	
0	2	2917	-2593	2593	2917	0	0	0	0	
0	3	0	-19	19	0	0	0	0	0	
1	-2	56	-35	-35	-56	0	0	0	0	
1	-1	-54	34	-34	-56	0	0	0	0	
1	0	4635	-2381	2337	2944	5434	5721	0	0	
1	1	-54	34	-34	-55	0	0	0	0	
2	-2	6	-3	-4	-6	0	0	0	0	
2	-1	-11	7	-7	-11	0	0	0	0	
2	0	-4662	2943	-2985	-4860	552	583	0	0	
2	1	-11	7	-7	-11	0	0	0	0	
3	-1	-3	2	-2	-3	0	0	0	0	
3	0	-1494	935	-947	-1529	84	89	0	0	
3	1	-3	2	-2	-3	0	0	0	0	
4	0	-412	257	-260	-419	15	16	0	0	
5	0	-110	69	-69	-112	3	3	0	0	
6	0	-29	18	-18	-30	0	0	0	0	
7	0	-7	5	-5	-8	0	0	0	0	
8	0	-1	2	0	-3	0	0	0	0	

		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	116	0	0	0	24	0	
0	1	0	0	-1	0	0	0	0	0	

Table A-8. (Cont.)
 Secular Terms
 a) Mercury on Neptune

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	191	0	-318	0	1	0
1	0	0	0	1	-82	25
2	-64	106	-106	-64	0	0
3	0	1	-1	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	2	0	-16	0	0	0
1	-3	-3	1	-3	-1	0
2	-3	2	6	0	0	0
3	3	-1	-2	0	0	0
4	0	-1	2	1	0	0
5	0	5	-1	-2	0	0
6	1	1	-1	-3	0	0
7	0	-2	1	-1	0	0
8	1	-3	1	2	0	0
9	-3	0	-4	-3	0	0
10	-2	7	-1	0	0	0
11	4	1	0	-1	0	0
12	-3	-4	-2	0	0	0

Table A-8. (Cont.)
 Periodic Terms
 b) Venus on Neptune

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	-311950	0	-4501	0	-881	0	0	0		
0	1	24350303	57	-96	24349839	0	0	0	0		
0	2	102411	-4500	4500	102409	0	-18	0	0		
0	3	654	-57	57	654	0	0	0	0		
0	4	5	0	0	5	0	0	0	0		
1	-3	2	-25	-25	-2	0	0	0	0		
1	-2	122	-1824	-1830	-122	0	0	0	0		
1	-1	-47	704	-728	-49	0	0	0	0		
1	0	75122	-1122981	1120183	74893	85763	6309	6	0		
1	1	-48	713	-713	-48	0	0	0	0		
1	2	0	2	-2	0	0	0	0	0		
2	-2	0	-6	-6	0	0	0	0	0		
2	-1	0	5	-5	0	0	0	0	0		
2	0	110	-1646	1633	109	294	22	0	0		
2	1	0	5	-5	0	0	0	0	0		
3	0	0	3	-3	0	2	0	0	0		
		NDZ		NU		D (LONG.)		D LOG(R)			
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	0	0	1671	0	0	0	352	0		
0	1	0	0	0	-1	0	0	0	0		
1	-2	0	0	0	-1	1	0	0	0		
1	-1	77	5	5	-77	77	5	1	-16		
1	0	-1	0	0	0	0	0	0	0		

Table A-8. (Cont.)

Secular Terms

b) Venus on Neptune

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-10	0	-424	0	21	0
1	0	0	0	0	-1618	-11
2	3	141	-141	3	-7	0
3	0	2	-2	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	1	0	-15	0	0	0
1	-6	1	-2	-2	-11	0
2	-4	3	6	-1	0	0
3	8	-1	-3	2	0	0
4	1	0	1	1	0	0
5	-3	3	-1	-1	0	0
6	2	1	0	-1	0	0
7	0	1	0	0	0	0
8	0	-4	3	1	0	0
9	-1	-2	-4	0	0	0
10	-1	9	0	-1	0	0
11	1	1	2	0	0	0
12	-1	-5	-1	0	0	0

Table A-8. (Cont.)
 Periodic Terms
 (c) Earth on Neptune

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-397035	0	-15943	0	-1147	0	0	0	
0	1	30226354	205	-337	30225879	0	0	0	0	
0	2	117318	-15940	15939	117317	-25	4	0	0	
0	3	661	-189	189	661	0	0	0	0	
0	4	4	-2	2	4	0	0	0	0	
1	-3	24	-36	-36	-24	0	0	0	0	
1	-2	1724	-2658	-2664	-1728	0	0	0	0	
1	-1	-413	637	-670	-435	0	0	0	0	
1	0	1280598	-1973904	1975733	1281262	47050	-82237	3	-6	
1	1	-421	650	-649	-421	0	0	0	0	
1	2	-2	4	-4	-2	0	0	0	0	
2	-3	0	-3	-3	0	0	0	0	0	
2	-2	14	-22	-22	-14	0	0	0	0	
2	-1	-7	10	-11	-7	0	0	0	0	
2	0	7636	-11769	11786	7643	395	-690	0	0	
2	1	-7	11	-11	-7	0	0	0	0	
3	0	57	-88	88	57	5	-9	0	0	

		NDZ		NU		D (LONG.)		D LOG(R)		
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	0	0	2074	0	0	0	437	0	
0	1	0	0	-2	-2	0	0	0	0	
1	-2	1	0	1	-1	2	1	0	0	
1	-1	135	88	88	-136	135	88	19	-29	
1	0	-2	-1	0	0	-1	0	0	0	
2	-1	1	1	1	-1	1	1	0	0	

Table A-8. (Cont.)
 Secular Terms
 c) Earth on Neptune

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-69	0	-966	0	-2	0
1	0	1	1	0	136	2464
2	23	322	-322	23	0	10
3	0	4	-4	0	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	-0	0	-15	0	-0	0
1	-8	1	-2	-2	1	16
2	-5	2	6	-1	0	0
3	6	-2	-3	2	0	0
4	0	-1	1	1	0	0
5	-3	2	-1	-1	0	0
6	2	1	0	-1	0	0
7	1	1	0	0	0	0
8	1	-4	3	1	0	0
9	0	-2	-4	0	0	0
10	-1	10	0	-1	0	0
11	1	1	2	0	0	0
12	-1	-5	-1	0	0	0

Table A-8. (Cont.)

Periodic Terms

d) Mars on Neptune

		DX		DY		DZ		U/COS(I)		
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN	
0	0	-46522	0	15967	0	1314	0	0	0	
0	1	3185320	-224	319	3185362	0	0	0	0	
0	2	7683	15964	-15964	7684	1	-9	0	0	
0	3	-65	134	-134	-65	0	0	0	0	
0	4	-1	0	0	-1	0	0	0	0	
1	-3	4	6	6	-4	0	0	0	0	
1	-2	177	486	486	-177	0	0	0	0	
1	-1	-23	-64	69	-25	0	0	0	0	
1	0	146350	400349	-401591	145494	-9223	17927	-1	1	
1	1	-24	-65	65	-24	0	0	0	0	
2	-3	-1	2	2	1	0	0	0	0	
2	-2	8	22	22	-8	0	0	0	0	
2	-1	-2	-5	6	-2	0	0	0	0	
2	0	5890	16113	-16157	5853	-429	834	0	0	
2	1	-2	-6	6	-2	0	0	0	0	
3	-2	0	2	2	0	0	0	0	0	
3	0	347	949	-951	344	-30	58	0	0	
4	0	23	64	-64	23	-2	5	0	0	
5	0	2	4	-5	2	0	0	0	0	

		NDZ		NU		D (LONG.)		D LOG(R)			
		(IN UNITS OF 10**(-4) SECONDS OF ARC)								(IN UNITS OF 10**(-9))	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	0	0	219	0	0	0	46	0		
0	1	0	0	-1	2	0	0	0	0		
1	-1	-27	10	10	28	-27	10	2	6		
2	-1	-1	0	0	1	-1	0	0	0		

Table A-8. (Cont.)

Secular Terms

d) Mars on Neptune

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	162	0	-191	0	8	0
1	0	0	0	1	-601	538
2	-54	64	-64	-54	-3	2

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	2	0	-16	0	0	0
1	-3	-3	0	-3	-4	4
2	-3	2	5	1	0	0
3	3	-1	-3	1	0	0
4	0	-1	1	1	0	0
5	0	5	-1	-1	0	0
6	1	1	-1	-2	0	0
7	0	-2	2	0	0	0
8	1	-3	2	3	0	0
9	-3	0	-3	-2	0	0
10	-2	7	0	1	0	0
11	4	1	1	-1	0	0
12	-3	-4	-1	0	0	0

Table A-8. (Cont.)
Periodic Terms
e) Jupiter on Neptune

		DX		DY		DZ		U/COS(I)			
		(IN UNITS OF 10**(-12))								(10**(-4) SECONDS OF ARC)	
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN		
0	0	-201944296	0	49211838	0	-1691481	0	-116	0		
0	1	9706316421	-933658	741172	9706566682	0	0	0	0		
0	2	-36775554	49213700	-49215523	-36777431	98671	-50603	7	-3		
0	3	-299498	-255008	255007	-299512	680	247	0	0		
0	4	2211	-4029	4029	2211	1	2	0	0		
0	5	40	-21	21	40	0	0	0	0		
1	-6	-15	-9	-9	15	0	0	0	0		
1	-5	-978	-346	-346	978	0	0	0	0		
1	-4	-49812	-34092	-34091	49811	14	3	0	0		
1	-3	-790741	-1718572	-1718558	790646	-48	872	0	0		
1	-2	6492611	3977790	3982930	-6503051	-33757	6766	-2	0		
1	-1	-469420	-330831	368558	-132570	-553	14010	0	0		
1	0	4143873104	2528566414	-2530719826	4141054709	22694134	78923325	1557	5416		
1	1	-303253	-97477	97564	-303236	3689	2981	0	0		
1	2	-1527	-2551	2552	-1526	18	62	0	0		
1	3	-86	172	-172	-86	0	0	0	0		
1	4	-4	4	-4	-4	0	0	0	0		
2	-6	-16	2	2	16	0	0	0	0		
2	-5	-173	-1142	-1142	173	0	0	0	0		
2	-4	67470	-17565	-17566	-67473	-28	40	0	0		
2	-3	1249456	2433040	2433239	-1249575	-1488	-539	0	0		
2	-2	111559	47032	55298	-98180	-745	211	0	0		
2	-1	196116	389928	-389329	195469	8327	-30248	1	-2		
2	0	97994700	59808737	-59849035	97946019	547493	1903885	38	131		
2	1	-6211	-3698	3697	-6212	9	10	0	0		
2	2	-18	-39	39	-18	0	0	0	0		
3	-7	-2	-1	-1	2	0	0	0	0		
3	-6	68	-136	-136	-68	0	0	0	0		
3	-5	7388	2399	2399	-7388	-4	2	0	0		
3	-4	-16782	242310	242334	16786	-84	-103	0	0		
3	-3	25712	45441	45285	-24323	-93	-46	0	0		
3	-2	1889	30793	-26602	-5893	2232	-2107	0	0		
3	-1	3733	7772	-7747	3689	174	-605	0	0		
3	0	3474886	2120954	-2122207	3473471	19799	68865	1	5		
3	1	-288	-176	176	-288	0	0	0	0		
3	2	0	-1	1	0	0	0	0	0		
4	-7	20	-12	-12	-20	0	0	0	0		
4	-6	662	788	788	-662	0	0	0	0		
4	-5	-15286	21769	21771	15288	-2	-14	0	0		
4	-4	-360	9119	9019	-474	-7	-14	0	0		
4	-3	-734	3164	-829	-2074	342	-74	0	0		
4	-2	90	1186	-997	-245	86	-81	0	0		
4	-1	91	201	-199	89	5	-16	0	0		
4	0	145976	89103	-89151	145925	849	2952	0	0		
4	1	-15	-9	9	-15	0	0	0	0		
5	-8	4	0	0	-4	0	0	0	0		
5	-7	21	146	146	-21	0	0	0	0		
5	-6	-2976	1320	1320	2977	0	-2	0	0		
5	-5	-858	1285	1267	863	0	-2	0	0		
5	-4	-230	434	239	-210	41	14	0	0		
5	-3	-60	152	-79	-103	20	-4	0	0		
5	-2	5	45	-36	-11	3	-3	0	0		
5	-1	3	6	-6	2	40	0	0	0		
5	0	6734	4111	-4113	6732	40	139	0	0		
6	-8	-9	21	21	9	0	0	0	0		
6	-7	-424	-52	-52	424	0	0	0	0		
6	-6	-235	109	107	235	0	0	0	0		
6	-5	-67	59	66	15	4	4	0	0		
6	-4	-18	21	6	-17	3	1	0	0		
6	-3	-3	7	-4	-5	0	0	0	0		
6	-2	0	2	-1	0	0	0	0	0		
6	0	330	201	-201	330	2	7	0	0		
7	-9	-3	2	2	3	0	0	0	0		
7	-8	-46	-36	-36	46	0	0	0	0		
7	-7	-43	-5	-5	43	0	0	0	0		
7	-6	-16	5	9	12	0	0	0	0		
7	-5	-4	3	3	0	0	0	0	0		
7	-4	-1	1	0	-1	0	0	0	0		
7	0	17	10	-10	17	0	0	0	0		
8	-9	-3	-8	-8	3	0	0	0	0		
8	-8	-6	-4	-4	6	0	0	0	0		
8	-7	-3	0	0	3	0	0	0	0		
8	-6	-1	0	0	0	0	0	0	0		
9	-10	0	-1	-1	0	0	0	0	0		
9	-9	-1	-2	0	0	0	0	0	0		
9	10	3	1	1	-3	0	0	0	0		
10	-10	0	-1	0	-1	0	0	0	0		
10	-9	1	-2	1	1	0	0	0	0		
10	10	-4	5	5	4	0	0	0	0		

Table A-8. (Cont.)
e) Jupiter on Neptune

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC				(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	666085	0	0	0	140245	0
0	1	-1	0	-10715	6754	0	0	-2256	1422
0	2	68	67	-99	5	68	67	-21	1
0	3	0	1	0	0	1	1	0	0
1	-4	0	0	0	0	0	1	0	0
1	-3	-5	10	19	11	-28	46	8	5
1	-2	-837	1249	2344	1335	-2311	3662	748	436
1	-1	-173265	283734	284717	173866	-173254	283714	59943	36605
1	0	2225	-3636	-28	-3	750	-1222	-260	-156
1	1	-75	-94	94	-76	-72	-99	20	-16
1	2	0	0	1	-1	-1	-1	0	0
2	-3	-3	-3	6	-1	-2	-3	1	0
2	-2	147	-56	150	217	112	1	38	49
2	-1	-4100	6713	6731	4111	-4099	6712	1417	866
2	0	53	-86	0	0	18	-29	-6	-4
2	1	-1	-2	2	-1	-1	-2	0	0
3	-4	0	0	1	0	0	0	0	0
3	-3	15	1	-1	19	15	1	0	4
3	-2	3	-1	4	4	2	1	1	1
3	-1	-145	238	239	146	-145	238	50	31
3	0	2	-3	0	0	1	-1	0	0
4	-4	1	1	-1	2	1	1	0	0
4	-3	1	0	0	1	1	0	0	0
4	-1	-6	10	10	6	-6	10	2	1

e) Jupiter on Neptune

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	5795606	0	373314	0	101279	0
1	24655	-529	-529	41092	-7935553	8696480
2	-1931589	-124434	124429	-1931519	-33758	36995
3	-24652	-1588	1588	-24651	-215	236
4	-280	-18	18	-280	-2	2
5	-3	0	0	-3	0	0

(THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	-29	0	91	0	666	0
1	3276	-50806	25398	1639	-52166	57168
2	3	-100	111	11	-222	243
3	4	-7	2	-3	-1	2
4	-7	-7	3	1	0	0
5	8	9	-4	-2	0	0
6	-1	-2	1	-1	0	0
7	-4	-3	0	0	0	0
8	3	0	-1	1	0	0
9	-4	4	0	-4	0	0
10	6	4	-5	1	0	0
11	-2	-2	0	-4	0	0
12	-2	6	0	2	0	0

Table A-8. (Cont.)
Periodic Terms
f) Saturn on Neptune

		DX		DY		DZ		U/COS(I)	
		(IN UNITS OF 10**(-12))							
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-83552147	0	-50624585	0	-1357472	0	-93	0
0	1	3075417509	1330384	-392569	3076112065	0	0	0	0
0	2	-31204001	-50634212	50637397	-31216052	-424385	-57900	-29	-4
0	3	-552388	794489	-794643	-552367	-494	5435	0	0
0	4	17124	6911	-6910	17126	78	-36	0	0
0	5	5	-302	302	5	-1	-1	0	0
0	6	-5	3	-3	-5	0	0	0	0
1	-8	12	-18	-18	-12	0	0	0	0
1	-7	896	-1512	-1512	-896	-1	-1	0	0
1	-6	-96676	-92849	-92856	96680	23	-65	0	0
1	-5	109457	-491429	-494696	-114847	-1418	989	0	0
1	-4	-3543440	989095	899341	3639919	-14480	-13377	-1	-1
1	-3	3646741	39856449	39659802	-3694913	-50063	107631	-3	7
1	-2	17954941	-19187396	-19042986	-17407093	859373	139745	59	10
1	-1	-1961451	139410	-246936	1933608	153650	35514	11	2
1	0	1844873767	-1962358665	1964117702	1843025309	9567086	44339207	657	3043
1	1	-946980	17066	-18303	-947450	-25574	28476	-2	2
1	2	11	18294	-18301	35	537	500	0	0
1	3	294	-1429	1430	294	3	-13	0	0
1	4	-38	-18	18	-38	0	0	0	0
2	-9	-2	-1	-1	2	0	0	0	0
2	-8	-5	31	31	5	0	0	0	0
2	-7	506	-120	-120	-506	2	1	0	0
2	-6	-5257	-7438	-7436	5257	9	-30	0	0
2	-5	-86706	130145	130144	86712	-486	21	0	0
2	-4	2319064	575979	576450	-2319297	2309	6036	0	0
2	-3	-1626587	-25459951	-25472406	1615875	45821	-34341	3	-2
2	-2	189911	229718	102283	173854	19325	-14176	1	-1
2	-1	-199945	-3113401	3111702	-196226	-220813	-132939	-15	-9
2	0	51177683	-54472254	54505960	51139882	269215	1255665	18	86
2	1	-3714	1965	-1967	-3713	-19	73	0	0
2	2	-41	21	-21	-41	0	0	0	0
2	3	0	-4	4	0	0	0	0	0
3	-9	3	3	3	-3	0	0	0	0
3	-8	40	-80	-79	-40	0	0	0	0
3	-7	-1699	-172	-172	1699	-3	-4	0	0
3	-6	7340	28683	28689	-7336	-53	62	0	0
3	-5	354530	-232393	-232357	-354702	957	399	0	0
3	-4	-2988745	-2487324	-2491111	2989365	1059	-8111	0	-1
3	-3	31693	-467764	-433616	28337	947	-5449	0	0
3	-2	-313150	-261726	263833	-317481	-45585	12732	-3	1
3	-1	-5543	-67710	67651	-5523	-4284	-2367	0	0
3	0	2134629	-2272069	2273184	2133321	11330	52671	1	4
3	1	-117	90	-90	-117	0	1	0	0
4	-10	1	0	0	-1	0	0	0	0
4	-9	-9	-23	-23	9	0	0	0	0
4	-8	-339	310	310	339	-1	0	0	0
4	-7	6550	3503	3506	-6551	2	19	0	0
4	-6	16285	-94095	-94123	-16323	201	-88	0	0
4	-5	-742555	88518	88024	743342	-930	-1193	0	0
4	-4	-105216	-106238	-92485	108287	-826	-1163	0	0
4	-3	-66065	-4649	-20386	-66817	-4657	8841	0	1
4	-2	-12841	-10788	10721	-13081	-1757	504	0	0
4	-1	-207	-2107	2104	-208	-130	-70	0	0
4	0	105475	-112265	112312	105418	565	2622	0	0
4	1	-6	5	-5	-6	0	0	0	0
5	-10	-7	-3	-3	7	0	0	0	0
5	-9	3	138	143	1	0	0	0	0
5	-8	1963	-679	-679	-1965	4	3	0	0
5	-7	-14400	-19112	-19124	14398	18	-49	0	0
5	-6	-96832	129787	129855	97064	-316	-39	0	0
5	-5	-45861	1857	4443	-44073	-383	-59	0	0
5	-4	-11587	5850	-14043	-3278	735	2162	0	0
5	-3	-4169	37	-913	-4208	-287	538	0	0
5	-2	-549	-459	451	-563	-73	21	0	0
5	-1	-9	-78	78	-9	-5	-3	0	0
5	0	5725	-6093	6096	5722	31	143	0	0
5	10	-6	6	6	6	0	0	0	0

Table A-8. (Cont.)
f) Saturn on Neptune

6	-10	34	29	32	-34	0	0	0	0
6	-9	229	-548	-568	-269	1	0	0	0
6	-8	-6318	-692	-695	6317	-6	-12	0	0
6	-7	6309	37099	37163	-6284	-57	44	0	0
6	-6	-9054	10592	10709	8320	-87	66	0	0
6	-5	-1955	2568	-2377	2798	498	230	0	0
6	-4	-831	675	-1039	-474	61	185	0	0
6	-3	-229	9	-44	-231	-16	29	0	0
6	-2	-25	-21	20	-26	-3	0	0	0
6	-1	0	-3	3	0	0	0	0	0
6	0	330	-351	351	330	2	8	0	0
6	10	56	-28	-28	-56	0	0	0	0
7	-10	-67	-170	-169	67	-1	2	0	0
7	-9	-1201	1132	1148	1456	-3	-1	0	0
7	-8	7582	5134	5155	-7600	-2	17	0	0
7	-7	467	4183	4090	-622	-4	31	0	0
7	-6	-145	977	391	1041	127	-50	0	0
7	-5	-83	279	-274	167	55	26	0	0
7	-4	-52	49	-67	-36	4	12	0	0
7	-3	-12	0	-2	-12	0	2	0	0
7	-2	-1	-1	0	-1	0	0	0	0
7	0	20	-21	21	20	0	0	0	0
7	9	-2	1	1	2	0	0	0	0
7	10	-372	26	26	372	0	0	0	0
8	-10	18	430	564	35	5	-2	0	0
8	-9	1764	-656	-281	-2760	3	3	0	0
8	-8	992	751	726	-1063	6	7	0	0
8	-7	139	283	374	74	13	-32	0	0
8	-6	19	88	-5	93	18	-7	0	0
8	-5	-2	23	-23	11	4	2	0	0
8	-4	-3	3	-4	-2	0	0	0	0
8	0	1	-1	1	1	0	0	0	0
8	9	2	22	22	-2	0	0	0	0
8	10	1401	558	558	-1401	0	0	0	0
9	-10	313	-687	-290	-405	-6	0	0	0
9	-9	1297	916	-1081	543	3	0	0	0
9	-8	60	45	99	-123	-4	-8	0	0
9	-7	20	36	11	17	2	-5	0	0
9	-6	6	6	-1	10	2	0	0	0
9	-5	0	1	-1	0	0	0	0	0
9	8	0	-1	-1	0	0	0	0	0
9	9	-18	61	61	18	0	0	0	0
9	10	-2781	-2804	-2809	2783	2	0	0	0
10	-10	621	-1354	1103	538	-4	2	0	0
10	-9	-353	-1507	1500	-430	-2	0	0	0
10	-8	35	11	0	19	0	-2	0	0
10	-7	5	-3	7	5	0	0	0	0
10	8	-4	14	14	5	0	0	0	0
10	9	-136	441	440	141	0	0	0	0
10	10	826	4507	4502	-816	3	3	0	0

Table A-8. (Cont.)
f) Saturn on Neptune

J	K	NDZ ----- (IN UNITS OF 10**(-4))		NU SECONDS OF ARC)-----		D (LONG.) -----		D LOG(R) (IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	0	0	211056	0	0	0	44438	0
0	1	1	0	-6080	-6949	0	0	-1280	-1463
0	2	-81	34	-95	57	-81	34	-20	12
0	3	0	1	1	1	0	2	0	0
1	-5	-9	10	-3	-3	-9	10	-1	-1
1	-4	-41	-12	6	-27	-41	-10	2	-6
1	-3	38	272	-217	49	78	286	-44	6
1	-2	3305	302	1325	1596	4440	1370	391	217
1	-1	133411	125310	127754	-136013	133425	125299	26897	-28633
1	0	-1730	-1550	-188	-13	-595	-484	-152	117
1	1	60	-61	61	63	58	-63	13	13
1	2	0	0	1	0	1	-1	0	0
2	-5	-1	0	0	-1	-1	0	0	0
2	-4	8	8	-6	9	8	6	-1	2
2	-3	58	-148	172	42	46	-147	36	10
2	-2	-1526	112	-93	-1989	-1494	141	-16	-422
2	-1	3740	3510	3510	-3743	3727	3511	739	-789
2	0	-48	-45	0	0	-16	-15	-3	3
2	1	1	-1	1	1	1	-1	0	0
3	-5	2	0	1	2	2	0	0	0
3	-4	-13	-25	26	-17	-14	-23	6	-3
3	-3	-152	183	-227	-189	-153	183	-48	-40
3	-2	-27	1	-1	-38	-27	4	0	-8
3	-1	156	146	147	-156	156	146	31	-33
3	0	-2	-2	0	0	-1	-1	0	0
4	-5	-6	-2	1	-7	-6	-1	0	-1
4	-4	6	46	-56	7	5	46	-12	1
4	-3	-6	7	-9	-8	-6	7	-2	-2
4	-2	-1	0	0	-1	-1	0	0	0
4	-1	8	7	7	-8	8	7	2	-2
5	-6	-1	1	-1	-1	-1	1	0	0
5	-5	8	6	-7	10	8	6	-2	2
5	-4	0	3	-3	0	0	3	-1	0
6	-6	2	0	0	3	2	0	0	1
6	-5	1	1	-1	1	1	1	0	0
7	-7	0	0	1	0	0	0	0	0

Table A-8. (Cont.)
 Secular Terms
 f) Saturn on Neptune

DX		DY		DZ		
(IN UNITS OF $10^{**}(-16)$)						
(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)						
J	COS	SIN	COS	SIN	COS	SIN
0	-19867317	0	8077890	0	146214	0
1	-84518	-11455	-11455	-140866	-11456401	-7839446
2	6621480	-2692533	2692435	6621241	-48736	-33349
3	84506	-34362	34361	84505	-311	-213
4	959	-390	390	959	-2	-2
5	11	-4	4	11	0	0

NDZ		NU		U/COS(I)		
(THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T						
WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)						
J	COS	SIN	COS	SIN	COS	SIN
0	-601	0	-387	0	961	0
1	70804	174134	-87066	35399	-75311	-51534
2	147	380	-365	152	-320	-219
3	6	-3	-3	2	-2	-1
4	-2	-1	0	-3	0	0
5	-2	2	-1	1	0	0
6	4	6	1	-2	0	0
7	-2	-13	-3	-2	0	0
8	2	4	2	2	0	0
9	-5	-1	-4	-1	0	0
10	-1	6	-2	1	0	0
11	6	0	-1	-1	0	0
12	-4	1	0	-4	0	0

Table A-8. (Cont.)
Periodic Terms
g) Uranus on Neptune

		DX		DY		DZ		U/COS(1)	
		(IN UNITS OF 10**(-12))							
J	K	COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-28736285	0	16013978	0	3201834	0	220	0
0	1	652395496	-2057818	-4140259	652948802	0	0	0	0
0	2	45910542	-48797045	48704556	46062461	-2598074	1176864	-176	81
0	3	109338	-1467281	1469944	117064	-52802	125233	-4	9
0	4	-64909	-44750	45163	-64754	3236	7020	0	0
0	5	-4976	1419	-1396	-4987	476	143	0	0
0	6	-145	327	-326	-146	29	-18	0	0
0	7	14	24	-24	14	0	-2	0	0
0	8	3	0	0	3	0	0	0	0
1	-9	-4	-3	-3	4	0	0	0	0
1	-8	-69	30	30	69	4	-4	0	0
1	-7	-746	2107	2109	744	-7	-74	0	0
1	-6	-27199	131610	131597	27144	-905	-639	0	0
1	-5	-3104647	11752709	11751782	3104133	-18062	6692	-1	0
1	-4	-350732986	1213808494	1213776882	350735374	-141605	763090	-10	52
1	-3	-43564397645	141434572650	141431913880	43564166521	18813941	106129098	1291	7283
1	-2	14059916828	20209231427	20095247860	-14213696674	-35840312	-23902722	-2459	-1640
1	-1	45914177579	-148895139980	148829017950	46030624259	20730230	-104772227	1423	-7190
1	0	-5017816242	-8930519182	8932119611	-5016301922	-941229	-5562557	-65	-382
1	1	-57646835	-99570594	99633279	-57656791	793539	509349	54	35
1	2	-756702	-915530	917227	-759592	49964	-12086	3	-1
1	3	-2524	8617	-8678	-2701	1476	-2794	0	0
1	4	1306	683	-690	1301	-77	-197	0	0
1	5	120	-46	46	120	-14	-5	0	0
1	6	4	-12	12	3	0	0	0	0
1	7	-1	-2	2	-1	0	0	0	0
2	-10	1	12	12	-1	0	0	0	0
2	-9	185	106	106	-185	-11	-1	0	0
2	-8	7488	742	735	-7488	-117	109	0	0
2	-7	524897	105870	105796	-524806	232	2653	0	0
2	-6	52484807	15229975	15230079	-52482376	69163	38277	5	3
2	-5	6120242595	2205735862	2205745267	-6120175549	7814663	125655	536	9
2	-4	7470940319	-3521326625	-3545766276	-7457684064	-5511645	3245259	-378	223
2	-3	-7164033798	-1353552502	3590490574	-6331440000	-156491	202735531	-11	13912
2	-2	-2731478558	1253229206	-1248347738	-2740224830	3696300	79313	254	5
2	-1	19168043	-129254399	129229842	18709857	5112476	-5634129	351	-387
2	0	-10252524	-17749029	17743713	-10261906	-115255	-819706	-8	-56
2	1	80913	-34826	33532	81133	-13740	-11496	-1	-1
2	2	4173	-5338	5300	4231	-1180	215	0	0
2	3	-98	-531	530	-97	-42	74	0	0
2	4	-48	-25	24	-49	2	6	0	0
2	5	-7	3	-4	-7	0	0	0	0
2	6	0	1	-1	0	0	0	0	0
3	-12	2	0	0	-2	0	0	0	0
3	-11	20	-22	-22	20	0	2	0	0
3	-10	97	-689	-689	-97	12	19	0	0
3	-9	8125	-34630	-34623	-8116	368	49	0	0
3	-8	1383449	-3173984	-3173751	-1383427	6672	-69688	0	0
3	-7	211292592	-362395363	-362388237	-211292332	154228	-733485	11	-50
3	-6	-228586250	-861190732	-860264910	231580554	390851	984807	27	68
3	-5	-41828821	536072423	-301041001	-456308134	30392575	4050916	2086	278
3	-4	325883787	259283053	-388323001	-157872837	-6597035	4478969	-453	307
3	-3	-32165903	-9096058	17523026	-26951571	-962213	-1040040	-66	-71
3	-2	-10904191	2420536	-2582176	-10804944	-3018390	-388023	-207	-27
3	-1	-239611	-63222	62936	-231434	-54607	24983	-4	2
3	0	-412389	-580115	580871	-411913	-4015	-11787	0	-1
3	1	-2241	-133	151	-2240	345	297	0	0
3	2	-138	174	-174	-135	34	-6	0	0
3	3	8	30	-30	9	1	-2	0	0
3	4	6	3	-2	6	0	0	0	0
3	5	1	0	0	1	0	0	0	0
4	-13	-2	-3	-3	2	0	0	0	0
4	-12	-81	-19	-19	81	3	-1	0	0
4	-11	-2981	-753	-752	2980	17	-49	0	0
4	-10	-234537	-139645	-139637	234519	-676	-1045	0	0
4	-9	-25441760	-21899218	-21899088	25441299	-74202	-31236	-5	-2
4	-8	-105810573	7841432	8194703	105770470	164222	-39522	11	-3
4	-7	56782063	-4440954	-58707974	4560636	1192386	-3959456	82	-272
4	-6	35390391	-59131203	-53254800	46803289	978743	1949639	67	134
4	-5	-66062890	-47772474	-57661195	58819107	1783053	774315	122	53
4	-4	4012743	3091602	-3916884	-3448492	-186588	656121	-13	45
4	-3	106136	349898	-87582	227698	629141	1206329	43	83
4	-2	67431	29849	-28694	65908	-9726	6648	-1	0
4	-1	-3919	18491	-18480	-4082	2278	-2203	0	0
4	0	-15831	-22511	22533	-15824	-154	-924	0	0
4	1	121	-8	13	119	-11	-9	0	0
4	2	15	-20	21	13	-1	0	0	0
4	3	-1	-6	6	-1	0	0	0	0
4	4	-1	0	0	-1	0	0	0	0

Table A-8. (Cont.)
g) Uranus on Neptune

5	-14	-4	10	10	4	0	0	0	0
5	-13	-83	306	306	83	-4	-4	0	0
5	-12	-15145	19349	19347	15144	-155	57	0	0
5	-11	-2365938	1901519	1901504	2365902	-5119	7626	0	1
5	-10	-1522062	13316911	13320160	1481890	-2227	-26217	0	-2
5	-9	-1256827	-7543240	-2785035	7412819	-490631	-245278	-34	-17
5	-8	-9509363	-6082935	4633490	10741753	422508	-133132	29	-9
5	-7	-15161720	14502152	12918061	16612775	291862	-512537	20	-35
5	-6	-2236417	32039152	31908186	3693600	-106628	-660083	-7	-45
5	-5	-1356703	-2093581	-1575293	1983403	344176	-105335	24	-7
5	-4	87845	528936	-565694	-163644	300030	-574187	21	-39
5	-3	-40889	-48186	52952	-38124	12505	19319	1	1
5	-2	10536	-4405	4344	10550	-2150	-231	0	0
5	-1	68	-77	75	47	-45	16	0	0
5	0	-806	-1125	1120	-811	-8	-28	0	0
5	1	-24	0	-2	-24	0	0	0	0
5	2	-5	5	-5	-4	0	0	0	0
5	3	0	2	-2	0	0	0	0	0
6	-16	1	0	0	-1	0	0	0	0
6	-15	34	11	11	-34	0	0	0	0
6	-14	1700	1684	1684	-1699	3	22	0	0
6	-13	141605	262125	262121	-141606	775	771	0	0
6	-12	1683583	525895	521239	-1684840	-4025	-315	0	0
6	-11	-1130119	177687	891778	768340	-43569	58562	-3	4
6	-10	-1120884	1417350	1855709	-284030	-10788	-79961	-1	-5
6	-9	2239146	3365291	3554201	-1928111	-98747	-78182	-7	-5
6	-8	9074415	2166262	2424356	-9004781	-228483	17628	-16	1
6	-7	12094794	-6990229	-6790851	-12211559	-201050	175699	-14	12
6	-6	-304336	1537506	1524652	360154	-153507	-126102	-11	-9
6	-5	264702	-270753	116317	404743	-318523	40669	-22	3
6	-4	-6248	47656	-48464	-14036	9850	-19269	1	-1
6	-3	-6292	-4038	4175	-6193	846	1509	0	0
6	-2	60	-20	-4	79	-19	9	0	0
6	-1	-15	95	-96	-6	2	-3	0	0
6	0	-21	-30	32	-19	0	-2	0	0
6	1	7	1	0	7	0	0	0	0
6	2	2	-1	1	2	0	0	0	0
7	-17	2	-4	-4	-2	0	0	0	0
7	-16	199	-154	-154	-199	3	0	0	0
7	-15	29373	-9527	-9528	-29372	110	-74	0	0
7	-14	113140	-210694	-210939	-112641	-150	599	0	0
7	-13	14231	177706	153683	-97996	6656	7135	0	0
7	-12	196952	205268	22407	-294746	-13952	-584	-1	0
7	-11	642387	-279035	-221633	-663725	-17423	15730	-1	1
7	-10	760665	-1775859	-1756007	-801440	-3541	52371	0	4
7	-9	-1631706	-4251083	-4269212	1585551	63989	80990	4	6
7	-8	-5841812	-2790968	-2809348	5833267	110185	35111	8	2
7	-7	869181	-445187	-312358	-918207	-10681	112013	-1	8
7	-6	-213334	-13677	170878	-175396	109718	121275	8	8
7	-5	27590	-16761	10376	33118	-16605	1733	-1	0
7	-4	196	5095	-5080	-31	645	-1265	0	0
7	-3	-30	-60	102	-16	26	39	0	0
7	-2	95	-46	56	90	-3	0	0	0
7	-1	10	-28	28	8	0	0	0	0
7	0	-5	-10	10	-6	0	0	0	0
7	1	-2	0	0	-2	0	0	0	0
8	-18	-14	-23	-24	15	0	0	0	0
8	-17	-451	-3337	-3337	453	-6	-15	0	0
8	-16	-25780	-20992	-20937	25822	85	38	0	0
8	-15	28105	1115	-8756	-27221	1111	-712	0	0
8	-14	36361	-25425	-44255	-13144	-518	2283	0	0
8	-13	-26048	-112039	-113632	16104	2180	3462	0	0
8	-12	-293800	-192012	-198287	289299	9963	2337	1	0
8	-11	-993971	200792	192053	995429	21892	-12924	2	-1
8	-10	-1325074	1942802	1938685	1332537	15511	-47818	1	-3
8	-9	490125	3090988	3087378	-506604	-11432	-51476	-1	-4
8	-8	-536293	-271595	-358722	474959	56804	-31141	4	-2
8	-7	74420	89880	-132662	-38099	19112	-82712	1	-6
8	-6	-19027	-7035	14830	-17051	7583	9081	1	1
8	-5	2821	-2216	1989	2940	-1133	129	0	0
8	-4	-57	-14	-1	-111	26	-51	0	0
8	-3	-106	-60	49	-112	2	3	0	0
8	-2	-33	9	-12	-33	0	0	0	0
8	-1	-5	9	-9	-4	0	0	0	0
8	0	0	2	-2	0	0	0	0	0
8	18	-4	0	0	4	0	0	0	0
9	-18	-3624	3022	3037	3612	6	-7	0	0
9	-17	784	-4419	-4530	324	-67	-166	0	0

Table A-8. (Cont.)

g) Uranus on Neptune

9	-16	-2896	-6205	-3358	6280	357	153	0	0
9	-15	-18405	908	-788	18354	632	-255	0	0
9	-14	-40961	63116	42233	41771	716	-1696	0	0
9	-13	5515	193768	193832	-3810	-1904	-4846	0	0
9	-12	405977	388813	389890	-404785	-12056	-5646	-1	0
9	-11	1259609	-10835	-11261	-1260301	-24729	6873	-2	0
9	-10	1128593	-1073814	-1086366	-1114595	-18686	16547	-1	1
9	-9	53222	563843	362934	13850	-33606	-17085	-2	-1
9	-8	6064	-65031	15503	77422	-41458	16611	-3	1
9	-7	3877	11559	-14102	-2787	2189	-7704	0	-1
9	-6	-2558	-656	867	-2423	572	678	0	0
9	-5	-52	133	-178	1	-57	5	0	0
9	-4	13	142	-140	27	1	-4	0	0
9	-3	31	27	-24	34	0	0	0	0
9	-2	12	-1	2	12	0	0	0	0
9	-1	2	-2	2	2	0	0	0	0
9	17	-2	2	2	2	0	0	0	0
9	18	-300	-6	-6	300	-2	0	0	0
10	-18	-875	546	579	854	-10	16	0	0
10	-17	-858	2732	2897	190	-23	-109	0	0
10	-16	5770	7871	7985	-5608	-262	-171	0	0
10	-15	33620	5136	5374	-33569	-951	202	0	0
10	-14	90832	-67558	-67216	-91148	-1601	2377	0	0
10	-13	49989	-318469	-318379	-49814	1166	7210	0	0
10	-12	-399974	-564426	-563854	-401649	10165	8903	1	0
10	-11	-774930	-163104	-148667	776210	11403	4346	1	0
10	-10	163666	-153451	-120273	-185135	2869	21913	0	2
10	-9	-29356	24767	36356	-28888	19816	13031	1	1
10	-8	3707	-5908	2554	8761	-4998	1680	0	0
10	-7	874	1909	-1882	662	183	-645	0	0
10	-6	263	-13	97	271	32	41	0	0
10	-5	130	-109	121	119	-4	0	0	0
10	-4	4	-49	49	0	0	0	0	0
10	-3	-9	-11	10	-9	0	0	0	0
10	-2	-3	0	0	-3	0	0	0	0
10	17	8	7	7	-8	0	0	0	0
10	18	717	179	179	-717	-4	0	0	0
11	-18	1429	-586	-713	-1371	40	-65	0	0
11	-17	2620	-5147	-5740	-1116	6	169	0	0
11	-16	-9108	-18441	-18466	9084	407	381	0	0
11	-15	-64986	-21462	-21606	64989	1652	-15	0	0
11	-14	-170022	82490	82941	169649	3000	-2838	0	0
11	-13	-130902	363885	365004	129755	1044	-7187	0	0
11	-12	157004	377484	371808	-163661	-565	-6147	0	0
11	-11	-133887	-28881	-49113	124393	9687	-8695	1	-1
11	-10	23666	2272	-25546	-11361	-331	-12665	0	-1
11	-9	-3575	475	4572	-3807	2725	2046	0	0
11	-8	807	-1685	1522	829	-468	156	0	0
11	-7	-226	-338	289	-312	15	-62	0	0
11	-6	-197	-53	34	-201	3	3	0	0
11	-5	-52	30	-34	-49	0	0	0	0
11	-4	-4	16	-16	-3	0	0	0	0
11	-3	2	3	-3	2	0	0	0	0
11	17	-20	-25	-25	20	0	0	0	0
11	18	-1909	-752	-752	1909	12	0	0	0
12	-18	-3555	713	1312	3381	-153	120	0	0
12	-17	-8620	9888	12680	3746	47	-331	0	0
12	-16	12266	40508	40599	-12293	-560	-803	0	0
12	-15	97869	55193	54574	-98030	-2329	-512	0	0
12	-14	211477	-57393	-58417	-211916	-3610	1628	0	0
12	-13	116617	-178932	-181031	-109387	-2813	1627	0	0
12	-12	32051	77707	78159	-19956	-7468	-1811	-1	0
12	-11	-9104	-12327	1282	16890	-5469	4018	0	0
12	-10	960	887	-3584	-2275	90	-2172	0	0
12	-9	-1835	450	-439	-1687	285	214	0	0
12	-8	-226	530	-578	-122	-35	8	0	0
12	-7	85	233	-224	106	0	-4	0	0
12	-6	65	30	-25	67	0	0	0	0
12	-5	18	-6	7	17	0	0	0	0
12	-4	2	-4	4	2	0	0	0	0
12	16	1	0	0	-1	0	0	0	0
12	17	64	116	116	-65	0	0	0	0
12	18	6498	3730	3728	-6498	-42	-8	0	0
13	-18	8335	373	-2097	-8041	489	-254	0	0
13	-17	23719	-15132	-26990	-9045	-208	550	0	0
13	-16	-5846	-67011	-66923	6593	521	1298	0	0
13	-15	-96737	-80007	-80332	97492	1811	1213	0	0
13	-14	-112695	1770	7115	110007	1449	1050	0	0
13	-13	28540	-43863	-37650	-10307	1607	4246	0	0
13	-12	-2679	9850	8308	-5503	3436	1176	0	0
13	-11	-31	463	-1197	3494	-1164	730	0	0
13	-10	1676	1320	-1110	1663	8	-253	0	0
13	-9	766	-148	280	742	19	20	0	0
13	-8	174	-249	264	151	-4	2	0	0
13	-7	-15	-85	84	-21	0	0	0	0
13	-6	-18	-13	12	-19	0	0	0	0
13	-5	-5	0	-1	-5	0	0	0	0
13	-4	-1	0	0	1	0	0	0	0
13	-3	0	0	-1	0	0	0	0	0
13	16	-6	0	0	6	0	0	0	0
13	17	-159	-475	-474	160	0	0	0	0
13	18	-20243	-16317	-16306	20249	127	47	0	0
14	-18	-16972	-5480	3877	17270	-1147	281	0	0
14	-17	-49412	5036	46244	12870	495	-692	0	0
14	-16	-5054	72324	73731	4982	62	-1205	0	0
14	-15	33715	49800	44656	-35554	209	-1008	0	0
14	-14	-33668	860	209	28680	1528	-2179	0	0
14	-13	6791	-2194	-4664	-2316	-528	-1857	0	0
14	-12	1714	-1194	4062	196	347	790	0	0
14	-11	69	-2599	2479	-239	-148	100	0	0
14	-10	-737	-724	611	-846	6	-19	0	0
14	-9	-374	0	-33	-372	4	2	0	0
14	-8	-74	74	-79	-68	0	0	0	0
14	-7	0	26	-26	1	0	0	0	0
14	-6	4	4	-4	0	0	0	0	0
14	-5	1	0	0	1	0	0	0	0
14	-4	6	0	0	-4	0	0	0	0
14	-3	25	0	0	-24	0	0	0	0
14	17	237	1756	1757	-244	-1	0	0	0
14	18	50573	57391	57349	-50606	-328	-189	0	0
15	-18	19874	19426	-4724	-26250	1946	-61	0	0
15	-17	68963	30459	-77387	-4074	-593	292	0	0
15	-16	14075	-28998	-28180	-7924	-590	145	0	0
15	-15	18784	18784	11882	-12156	-1538	-36	0	0
15	-14	-3914	-4022	166	1581	-639	780	0	0

Table A-8. (Cont.)
g) Uranus on Neptune

15	-13	-3687	-1156	-1777	-4857	-93	-531	0	0
15	-12	-2740	1870	-2193	-2380	120	41	0	0
15	-11	-227	1330	-1358	-45	-13	1	0	0
15	-10	265	377	-353	296	0	-5	0	0
15	-9	123	22	-13	124	0	0	0	0
15	-8	24	-17	18	23	0	0	0	0
15	-7	1	-6	6	0	0	0	0	0
15	-6	-3	-4	-4	3	0	0	0	0
15	-5	-26	-6	-7	26	0	0	0	0
15	-4	-97	13	8	100	0	0	0	0
15	-3	474	-4458	-4467	-439	2	-1	0	0
15	-2	-93155	-152715	-152585	93314	546	537	0	0
16	-18	-14913	-41344	23608	36261	-1275	-1055	0	0
16	-17	-53215	-96716	100919	-21996	228	259	0	0
16	-16	5499	-18314	-9624	2153	441	734	0	0
16	-15	-2225	5078	-1412	791	503	38	0	0
16	-14	2031	5712	-4661	5208	-249	225	0	0
16	-13	4073	1506	-850	4201	-33	-86	0	0
16	-12	1583	-747	940	1486	3	9	0	0
16	-11	193	-535	548	150	-3	4	0	0
16	-10	-64	-136	131	-72	0	0	0	0
16	-9	-32	-12	10	-33	0	0	0	0
16	-8	-6	3	-3	-6	0	0	0	0
16	-7	0	1	-1	0	0	0	0	0
16	-6	-2	4	4	2	0	0	0	0
16	-5	9	20	20	-8	0	0	0	0
16	-4	94	37	42	-92	0	0	0	0
16	-3	331	-17	10	-342	-2	2	0	0
16	-2	-2615	11376	11429	2489	-5	3	0	0
16	-1	100438	278091	277791	-100988	-773	-1008	0	0
17	-18	-28608	26962	-11120	-35205	-261	861	0	0
17	-17	5093	111693	-96472	23097	220	-367	0	0
17	-16	7240	1118	3094	2664	-119	-191	0	0
17	-15	5031	-7440	9502	1822	199	68	0	0
17	-14	-1484	-5566	5240	-2306	-32	64	0	0
17	-13	-1963	-1120	895	-2082	8	-2	0	0
17	-12	-676	184	-234	-660	5	0	0	0
17	-11	-89	155	-160	-79	0	0	0	0
17	-10	10	38	-38	12	0	0	0	0
17	-9	7	4	-4	7	0	0	0	0
17	-8	1	0	0	1	0	0	0	0
17	-7	3	0	0	-3	0	0	0	0
17	-6	9	-15	-15	-10	0	0	0	0
17	-5	-20	-75	-76	15	0	0	0	0
17	-4	-259	-153	-172	247	2	0	0	0
17	-3	-811	153	51	833	5	-2	0	0
17	-2	9487	-6304	-6527	-9153	2	-9	0	0
17	-1	-55388	-305130	-304778	56834	-420	966	0	0
18	-18	36618	-97661	98683	11718	863	359	0	0
18	-17	4248	-42893	34141	400	-10	68	0	0
18	-16	-12910	26	-4584	-12514	-9	-135	0	0
18	-15	-4936	5893	-6543	-3998	59	-19	0	0
18	-14	270	2893	-2855	568	-4	-11	0	0
18	-13	663	550	-501	699	-3	-5	0	0
18	-12	210	-19	31	209	-1	0	0	0
18	-11	29	-35	36	27	0	0	0	0
18	-10	0	-9	9	-1	0	0	0	0
18	-9	-1	0	0	-1	0	0	0	0
18	-8	-2	-2	-2	2	0	0	0	0
18	-7	-14	1	0	14	0	0	0	0
18	-6	-38	45	42	41	0	0	0	0
18	-5	19	219	220	-1	0	-1	0	0
18	-4	521	442	500	-467	-2	-2	0	0
18	-3	1529	265	551	-1533	-10	5	0	0
18	-2	-7018	31709	32354	6301	-13	-5	0	0
18	-1	-24162	100698	100555	21953	240	-161	0	0

Table A-8. (Cont.)
g) Uranus on Neptune

J	K	NDZ		NU		D (LONG.)		D LOG(R)	
		(IN UNITS OF 10**(-4))		SECONDS OF ARC)		(IN UNITS OF 10**(-9))		(IN UNITS OF 10**(-9))	
		COS	SIN	COS	SIN	COS	SIN	COS	SIN
0	0	-80	0	98373	0	0	0	20724	0
0	1	1	911	10227	-11649	0	0	2249	-2452
0	2	-138	-24	102	-403	-218	-98	26	-89
0	3	-2	0	-7	-9	-5	-2	-1	-2
0	4	0	0	-1	0	0	0	0	0
1	-5	0	0	1	1	20	5	1	-2
1	-4	2	-15	21	5	1801	494	70	-226
1	-3	-877	-5812	-2088	-139	168697	46437	5059	-17886
1	-2	19905674	6155146	162423	-519514	19921898	6143664	33000	-111096
1	-1	1905218	-1340617	597758	849647	2074557	-1288248	120347	196717
1	0	2994	58	464	3525	20980	-10769	1227	2675
1	1	68	37	-44	90	285	-81	5	46
1	2	1	0	0	4	4	-1	0	1
2	-7	0	0	0	0	0	-1	0	0
2	-6	-4	-1	9	3	12	-71	-7	-2
2	-5	-984	231	639	765	1476	-6908	-620	-99
2	-4	322180	-875037	-1403	12031	319382	-880902	-909	2825
2	-3	-332179	-700701	339467	-158475	-328457	-708256	72327	-33128
2	-2	85069	29837	-22473	65069	82262	23689	-4088	13404
2	-1	1516	-871	-645	-507	2203	-686	-154	-34
2	0	-12	-2	22	3	8	-7	5	3
2	1	0	0	1	-1	0	0	0	0
3	-8	0	1	0	-1	-4	-1	0	0
3	-7	7	115	79	-50	-418	-129	-9	34
3	-6	-52755	-31681	299	270	-53424	-31499	82	125
3	-5	-83072	22172	-10556	-41441	-83477	21740	-2206	-8784
3	-4	9058	-15956	12016	6640	8270	-15913	2495	1325
3	-3	-4589	-17415	16008	-4200	-4518	-17547	3385	-877
3	-2	304	112	-64	273	266	-38	2	53
3	-1	35	-24	-32	-44	37	-24	-7	-9
3	0	-1	0	0	0	0	0	0	0
4	-9	13	2	-3	-8	-13	32	3	1
4	-8	-3359	3755	89	59	-3352	3838	27	12
4	-7	792	10371	-5092	336	740	10389	-1078	70
4	-6	-2426	-2034	1476	-1806	-2455	-1936	301	-376
4	-5	-4166	351	-356	-3748	-4217	372	-69	-788
4	-4	-3648	4302	-4275	-3637	-3685	4303	-901	-770
4	-3	-48	-245	235	-60	-80	-208	46	-16
4	-2	8	3	-3	10	7	1	0	2
4	-1	2	-1	-1	-1	2	-1	0	0
5	-11	0	-1	-1	0	3	1	0	0
5	-10	282	371	17	-13	293	372	4	-4
5	-9	1322	147	-77	631	1321	153	-16	134
5	-8	-405	334	-247	-292	-394	342	-51	-60
5	-7	-72	761	-678	-53	-67	773	-142	-12
5	-6	948	1139	-1102	940	966	1148	-233	196
5	-5	2161	204	-216	2238	2168	215	-46	472
5	-4	-116	117	-123	-114	-98	119	-26	-22
5	-3	-2	-8	9	-3	-2	-7	2	-1
6	-12	42	-21	-1	-3	42	-22	0	-1
6	-11	52	-169	78	25	53	-169	17	5
6	-10	41	75	-54	30	43	74	-11	6
6	-9	124	35	-29	110	126	34	-6	23
6	-8	252	-143	143	241	254	-148	30	51
6	-7	169	-620	635	164	167	-628	133	35
6	-6	-459	-813	861	-484	-457	-818	182	-102
6	-5	102	19	-17	107	98	12	-3	22
6	-4	-5	5	-6	-5	-4	5	-1	-1
7	-14	-1	-5	0	0	-1	-5	0	0
7	-13	-21	-11	5	-10	-21	-11	1	-2
7	-12	13	-4	3	9	13	-5	1	2
7	-11	9	-19	17	8	9	-19	3	2
7	-10	-17	-48	45	-17	-18	-48	10	-3
7	-9	-122	-58	56	-124	-124	-57	12	-26
7	-8	-291	104	-113	-303	-294	107	-23	-64
7	-7	-187	388	-414	-201	-189	388	-87	-42
7	-6	-27	-58	61	-29	-28	-55	12	-6
7	-5	5	1	-1	6	5	1	0	1
8	-16	-1	0	0	0	-1	0	0	0
8	-15	-2	3	-1	-1	-2	3	0	0
8	-14	0	-2	2	0	0	-2	0	0
8	-13	-3	-2	2	-2	-3	-2	0	0
8	-12	-8	1	-1	-8	-8	1	0	-2
8	-11	-14	20	-20	-14	-14	21	-4	-3
8	-10	12	69	-71	14	13	70	-15	3
8	-9	129	92	-95	138	131	92	-20	29
8	-8	205	-33	34	220	206	-32	7	46
8	-7	-20	34	-36	-21	-18	34	-8	-4
8	-6	-1	-4	4	-2	-2	-3	1	0

Table A-8. (Cont.)
g) Uranus on Neptune

9	-14	0	1	-1	0	0	1	0	0
9	-13	3	3	-3	3	3	3	-1	1
9	-12	13	0	0	14	14	0	0	3
9	-11	27	-27	29	28	27	-28	6	6
9	-10	0	-64	90	0	0	-85	19	0
9	-9	-71	-74	80	-77	-71	-75	17	-16
9	-8	24	-2	2	25	23	-2	1	5
9	-7	-2	2	-3	-2	-1	2	-1	0
10	-15	1	0	0	1	1	0	0	0
10	-14	0	-2	2	0	0	-2	1	0
10	-13	-4	-6	7	-5	-5	-6	1	-1
10	-12	-21	-4	4	-23	-22	-4	1	-5
10	-11	-38	26	-28	-41	-38	27	-6	-9
10	-10	-10	51	-55	-11	-11	51	-12	-2
10	-9	-9	-11	12	-10	-9	-11	2	-2
10	-8	2	0	0	2	2	0	0	0
11	-15	-1	1	-1	-1	-1	1	0	0
11	-14	-2	4	-5	-2	-2	5	-1	0
11	-13	5	12	-12	6	5	12	-3	1
11	-12	24	9	-9	26	25	9	-2	5
11	-11	25	-11	11	27	25	-11	2	6
11	-10	-2	9	-9	-3	-2	9	-2	-1
11	-9	-1	-1	1	-1	-1	-1	0	0
12	-16	1	0	0	1	1	0	0	0
12	-15	3	-1	1	3	3	-1	0	1
12	-14	4	-6	7	4	4	-7	1	1
12	-13	-4	-14	15	-4	-4	-14	3	-1
12	-12	-12	-7	8	-13	-12	-8	2	-3
12	-11	5	-2	2	5	5	-2	0	1
12	-10	0	1	-1	0	0	1	0	0
13	-18	0	1	1	0	0	1	0	0
13	-17	0	-1	1	0	0	-1	0	0
13	-16	-1	-1	1	-1	-1	-1	0	0
13	-15	-4	0	-1	-5	-4	0	0	-1
13	-14	-5	7	-7	-6	-5	7	-1	-1
13	-13	0	7	-8	0	0	7	-2	0
13	-12	-3	-2	2	-3	-3	-2	0	-1
13	-11	1	0	0	1	1	0	0	0
13	-10	-1	1	-1	-1	-1	1	0	0
14	-18	1	-1	-1	-1	1	-1	0	0
14	-17	0	1	-1	0	0	1	0	0
14	-16	2	2	-2	2	2	2	0	0
14	-15	5	0	-1	5	5	0	0	1
14	-14	3	-2	3	3	3	-2	1	1
14	-13	0	2	-2	0	0	2	0	0
14	-12	4	-3	3	4	4	-3	1	1
15	-19	-1	0	0	1	-1	0	0	0
15	-18	-4	2	2	4	-4	2	0	1
15	-17	1	-1	2	0	1	-1	0	0
15	-16	-2	-2	3	-1	-2	-2	1	0
15	-15	-2	-1	1	-2	-2	-1	0	0
15	-14	1	-1	1	-1	1	-1	0	0
15	-13	-10	6	-6	-10	-10	6	-1	-2
16	-19	2	1	1	-2	2	1	0	0
16	-18	7	-3	-3	-7	7	-3	-1	-1
16	-17	0	2	-2	-1	0	2	0	0
16	-16	0	1	-1	0	0	1	0	0
16	-15	-1	0	0	-1	-1	0	0	0
16	-14	1	0	0	1	1	0	0	0
16	-13	19	-7	7	19	19	-7	1	4
17	-19	-1	-2	-2	1	-1	-2	0	0
17	-18	-7	1	1	7	-7	1	0	2
17	-17	1	0	1	0	1	0	0	0
17	-16	1	1	0	0	1	1	0	0
17	-15	1	0	0	0	1	0	0	0
17	-14	0	-1	1	0	0	-1	0	0
17	-13	-21	4	-4	-21	-21	4	-1	-4
18	-19	7	2	2	-7	7	2	0	-1
18	-18	3	0	0	-3	3	0	0	-1
18	-17	0	-2	0	0	0	-2	0	0
18	-16	-1	0	0	0	-1	0	0	0
18	-15	2	0	0	2	2	0	0	0
18	-14	7	2	-2	7	7	2	0	1

Table A-8. (Cont.)
 Secular Terms
 g) Uranus on Neptune

	DX		DY		DZ	
	(IN UNITS OF 10**(-16))					
	(TO BE MULTIPLIED BY TIME IN DAYS FROM EPOCH 1850.0)					
J	COS	SIN	COS	SIN	COS	SIN
0	-49321389	0	-48834193	0	140537	0
1	-209422	69835	68666	-349308	-11011604	27775318
2	16438083	16277480	-16276891	16437488	-46843	118157
3	209790	207732	-207729	209786	-299	754
4	2380	2357	-2356	2380	-2	6
5	26	26	-26	26	0	0

NDZ NU U/COS(I)
 (THE TERMS ARE IN UNITS OF $10^{**}(-6)$ SECONDS OF ARC AND ARE TO BE MULTIPLIED BY N*T
 WHERE N=THE MEAN MOTION OF THE DISTURBED PLANET (RAD/DAY) AND T=TIME IN DAYS FROM EPOCH)

J	COS	SIN	COS	SIN	COS	SIN
0	3633	0	-935	0	924	0
1	-428033	432322	-216155	-214017	-72387	182586
2	-907	914	-913	-913	-308	777
3	-5	-2	-4	-8	-2	5
4	2	2	0	1	0	0
5	-2	2	0	-2	0	0
6	-1	1	-1	2	0	0
7	4	-3	-5	2	0	0
8	-4	3	-2	-2	0	0
9	-2	-4	-1	-2	0	0
10	4	1	-4	0	0	0
11	-6	3	3	1	0	0
12	1	2	-2	0	0	0
13	3	-5	-2	0	0	0
14	-4	2	0	2	0	0
15	2	-3	-2	-2	0	0
16	4	-1	-1	0	0	0
17	-2	1	2	-1	0	0
18	-1	-2	2	-2	0	0
19	1	-1	1	-1	0	0
20	-3	5	-2	0	0	0

BIOGRAPHICAL NOTE

SALAH E. HAMID received his B. S. C. from Cairo University in 1944 and his Ph. D. in astronomy from Harvard in 1950.

Dr. Hamid was an assistant professor of astronomy on the Faculty of Sciences, Cairo University, and has also held the position of director of the Operation Research Center of the National Planning Institute of Cairo, the U. A. R. He joined SAO in 1961 as a celestial mechanician.

NOTICE

This series of Special Reports was instituted under the supervision of Dr. F. L. Whipple, Director of the Astrophysical Observatory of the Smithsonian Institution, shortly after the launching of the first artificial earth satellite on October 4, 1957. Contributions come from the Staff of the Observatory.

First issued to ensure the immediate dissemination of data for satellite tracking, the reports have continued to provide a rapid distribution of catalogs of satellite observations, orbital information, and preliminary results of data analyses prior to formal publication in the appropriate journals. The Reports are also used extensively for the rapid publication of preliminary or special results in other fields of astrophysics.

The Reports are regularly distributed to all institutions participating in the U. S. space research program and to individual scientists who request them from the Publications Division, Distribution Section, Smithsonian Astrophysical Observatory, Cambridge, Massachusetts 02138.