reduced accuracy for use in obtaining approximate positions at remote dates will probably be replaced by ephemerides to a low order of precision extending over the whole of historic time.

Although printed co-ordinates, to a reduced accuracy, will be required for the positioning of telescopes, the fundamental planetary ephemerides, accumulating year after year on library shelves, as the standard for comparison with observations seem certain to be replaced by compilations of data in machine-readable form, since undoubtedly, all future analyses of observation residuals will be performed with the aid of electronic calculating equipment.

While the fundamental ephemerides may no longer be printed in the annual volumes, they should continue to be published, to full accuracy, in the same form as the co-ordinates of the Sun (2) and Venus (3) for 1800–2000. As in these volumes, the rectangular co-ordinates as well as the spherical co-ordinates will undoubtedly be required.

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5. THEORY OF THE MOTIONS OF MARS AND THE EARTH

G. M. Clemence

My first-order theory of the heliocentric motion of Mars was published in 1949 in *Astronomical Papers of the American Ephemeris*, Vol. XI, Part II. The theory has recently been completed by the addition of the perturbations of the second and third orders, which will be published late in 1961 or early in 1962 in Vol. XVI, Part II of the same series. My aim has been to calculate all of the inequalities in the motion having coefficients as large as 0″0001 in the case of the periodic terms, and 0″0001 per century in the case of the secular and mixed terms.

The following tabulation shows for the complete theory the number of inequalities in the mean longitude arising from various sources, the mass-factors being denoted by the initial letters of the planets concerned. Thus, S denotes terms factored by the mass of Saturn, V^2 terms factored by the square of the mass of Venus, and J^2ST terms factored by the square of the mass of Jupiter, the mass of Saturn, and the time.

First order		Second order		Third order	
Source	No.	Source	No.	Source	No.
Me	11	V^2 and VM	5	J^2S and JS^2	5
V	45	E^2 and EM	30	J^2ST and JS^2T	37
E	157	J^2 and JM	22	J^2ET	1
J	73	S^2 and SM	5	J^2E	56
S	43	V^2T and VMT	12	Total	99
U	16	E^2T and EMT	47		
N	10	J^2T and JMT	25		
Total	355	S^2T and SMT	14		
		EV	31		
		JE	96		
		SJ	261		
		JV	10		
		SE	13		
		US	7		
		Total	578		

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Not all of the 1032 terms are distinct in form; in 160 cases the same arguments arise from more than one source, and these terms may be combined for evaluation. The number of terms in the radius vector is about the same as in the longitude, and the number of terms in the latitude is about half as great. Thus, about 2000 terms must be evaluated in order to obtain the position of Mars at one instant of time.

The crucial test of the theory is of course its agreement with observations, but observations of modern precision have been made only during the past two centuries, the standard error of a single observation varying between $0''\cdot5$ and $1''\cdot0$. Furthermore, the comparison of the new theory with observations would necessarily be contaminated by defects in Newcomb's theory of the Earth. Desiring to apply a more searching test than existing observations are capable of providing, I have compared the theory with a numerical step-by-step integration of the orbit of Mars, calculated for the years 1919 to 1954 by Dr Paul Herget with the Naval Ordnance Research Calculator. The comparison was made at intervals of 80 days. After removal of an elliptic correction arising from small differences in the constants of the orbit, which amounted to permitting four degrees of freedom in the longitude, none in the radius, and two in the latitude, the standard deviation of a difference in longitude is $0''\cdot02$, the largest being $0''\cdot04$. The discrepancies in radius vector are of the same order of magnitude, and those in latitude somewhat smaller. Thus, there is some ground for belief that the theory will be practically useful for some centuries to come.

I have commenced a new general theory of the motion of the Earth. The first-order portion is now complete, the perturbations having a precision of $0''\cdot00001$. The results agree well with those of Leverrier and Newcomb, my own having, however, two additional significant figures. The interesting portions of the theory will therefore be the higher-order portions, neglected by previous authors.

6. NECESSITE D'UNE NOUVELLE THEORIE DES QUATRE GROS SATELLITES DU JUPITER

J. Kovalevsky

Le problème du mouvement des quatre gros satellites de Jupiter est un des problèmes les plus difficiles qui se posent dans le cadre de l'interprétation, à l'aide de la théorie de la gravitation du mouvement des corps du Systéme Solaire. Etant donné que ce sont, parmi les satellites autres que la Lune, ceux qui sont les plus accessibles aux observations, il est naturel que les grandes éphémérides leur consacrent une partie importante de la place réservée aux satellites, en particulier pour la prédiction des configurations, des éclipses, des occultations et des passages. Il est probable que, dans un proche avenir, des éphémérides très précises soint demandées pour ces corps. Or la théorie est actuellement loin de pouvoir satisfaire à de telles exigences.

Dans le passe, très peu de théories de ces corps ont été développées et encore moins ont été achevées au point de donner lieu à des Tables qui permettent le calcul d'éphémérides. En fait, depuis Laplace, seuls Damoiseau et Sampson ont fait le travail complet, tandis que Delambre, Souillart et de Sitter ont fait une théorie incomplète ou inachevée.

La raison de cette carence ne reside pas dans le fait que les théories existantes seraient satisfaisantes. Elle sont loin de l'être. La raison réside bien dans la difficilté et la complexité du problème. Une thèorie complète des quatre satellites entraine, par exemple, la détermination de 31 constantes: les 24 constantes d'integration pour les satellites, leurs quatre masses et trois paramètres déterminant le bourrelet équatorial de Jupiter en grandeur